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SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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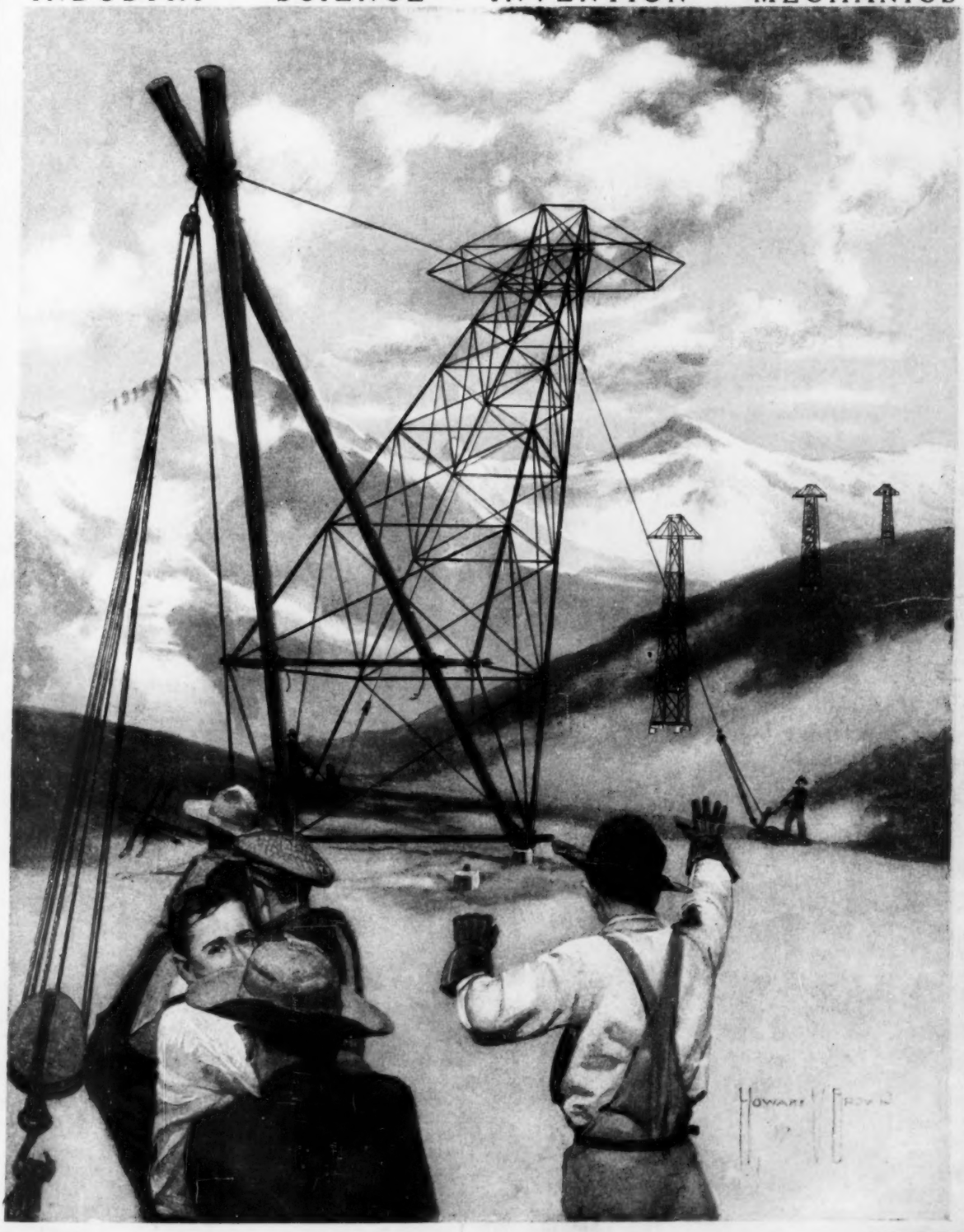

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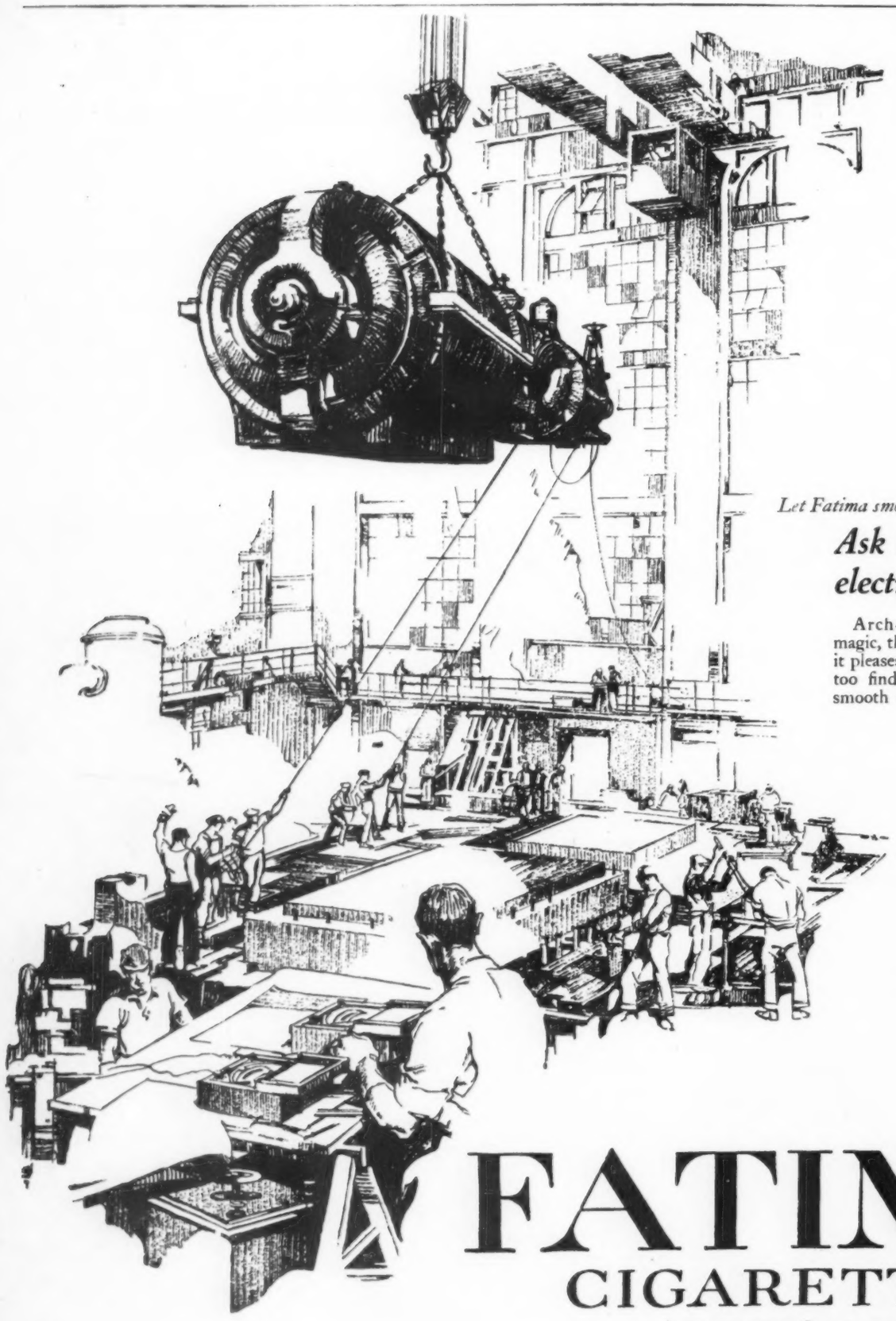
Vol. CXXV. No. 5
July 30, 1921

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 15 Cents
20 cents in Canada



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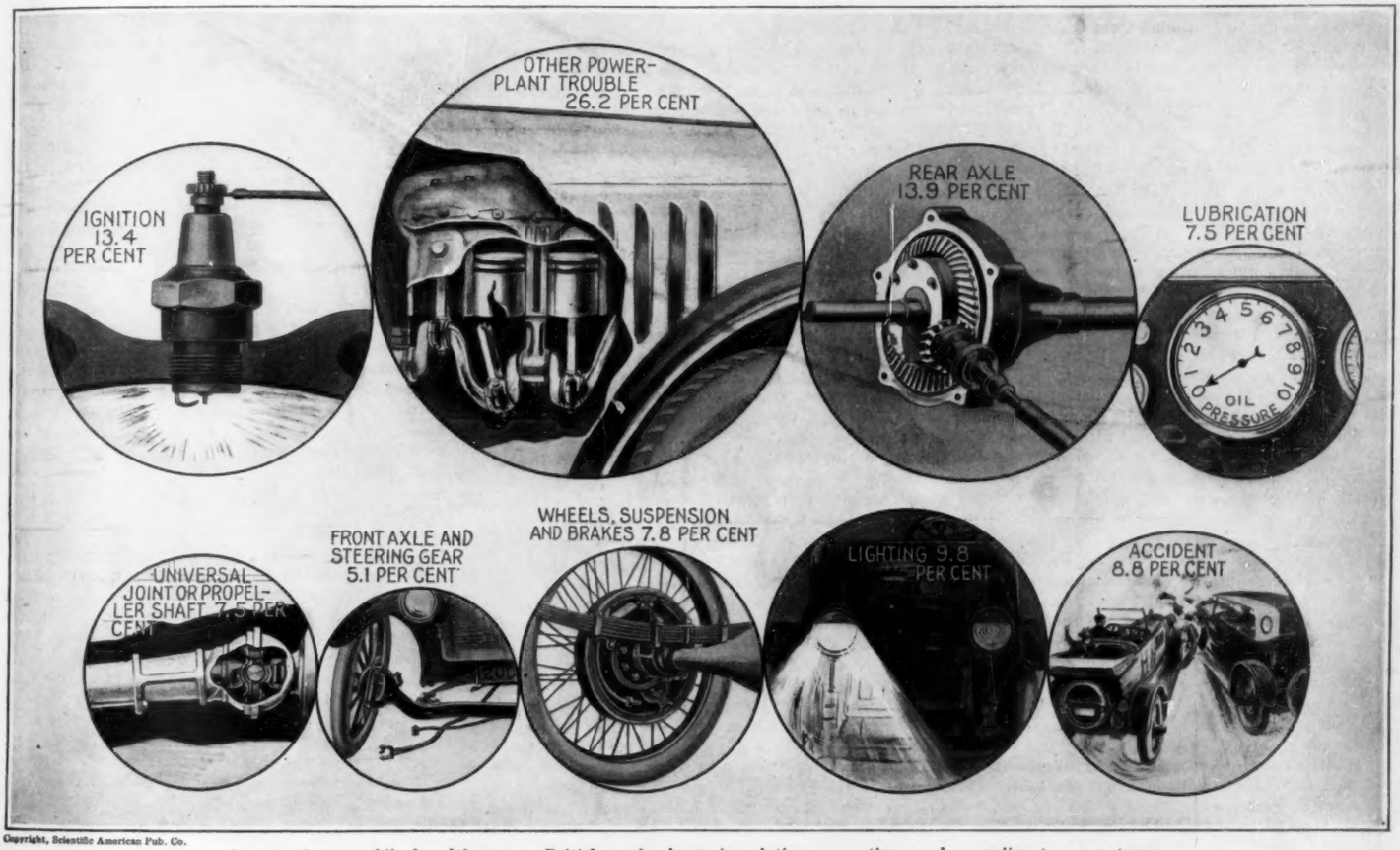
VOLUME CXXV. NUMBER 5 | NEW YORK, JULY 30, 1921 | 15 CENTS A COPY 20 CENTS IN CANADA



Causes of automobile breakdowns on British roads shown in relative proportions and according to percentages

British Roadside Breakdowns

THE Royal Automobile Club of England has for some years maintained a flying squadron of trouble chasers who go to the rescue of members stranded on the roads with a machine that cannot be made to do its duty. The activities of these service men over a considerable period have just been collected into a report from which are compiled figures showing the various causes of disabling breakdowns. Tire trouble and the minor ills that the motorist corrects for himself are of course not included; only those breakdowns are reported which were beyond the motorist's ability to effect temporary repairs.

It will be seen from the graphic chart on this page that 68.5 per cent of the crippled cars result from power-plant and transmission troubles, and 31.5 per cent from failure of some subsidiary feature of the car. It stands to reason that in the great majority of cases where a car is incapacitated the trouble is due to the refusal of the motor to furnish power, or to the impossibility of delivering its power to the rear wheels. Of the specific items, first place is disputed between the ignition system and the rear axle. 134 cars out of every 1000 that have to send for assistance at the roadside owe their troubles to the failure of the spark, and 139 more are unable to run because of breakdown in the unit that carries the power from the propeller shaft to the wheels. Further localization of power-plant difficulties shows that 7½ per cent of the emergency calls are in response to lubrication systems that have refused to lubricate, and that another 7½ per cent owe their origin to difficulties in the universal joint or propeller shaft—parts which by virtue of their comparative inaccessibility and immunity from the necessity for ordinary adjustment are perhaps more of a sealed book to the average driver than any other region of the car. Then there is a large 26.2 per cent of breakdowns that are attributed to unclassified difficulties with the power plant. Under this head we may visualize broken crankshafts, connecting rods loose beyond the point of toleration, valve failure, etc. Doubtless a carburetor blown out by back-fire would come under this head; and since there is no other place for it, we suspect that a car compelled to lay up for want of water circulation would be considered a power-plant casualty. It would be interesting to have this item further analyzed, but we can only present the figures as they come to us. The heavy toll of rear-axle trouble, it is suggested, is probably due in large part to wheels that were loose on the driving shafts, causing a play that resulted in breakage.

Passing from the power plant, it appears that the heaviest demands upon the emergency squad are made by the failure of the lighting system at night. For practically eleven per cent of all crippled cars to be attributable to this cause seems very high, and leads us to wonder whether the flashlight is in such common use in Great Britain as it is here, and whether British cars are so generally equipped with a reliable battery and generator. In this respect at least we are sure that these figures would not be valid for American motoring.

On the other hand, the British driver must be constitutionally a more cautious species than his American brother if he is able to show that only 8.8 per cent of his crippled cars owe their troubles to accident. The average American driver we believe could achieve this result all by himself, with the aid of sharp curves and railroad crossings, without calling into play at all the services of other drivers to run into him or crowd him into the ditch. Of course the universal severity and rigid enforcement of traffic laws in the United Kingdom may have something to do with it; and we rather suspect that as large a contribution as any to the result may be seen in the pleasant British custom of "endorsing" on the motorist's license every little thing that ever happens to him from the time he leaves his garage until he is safely under roof again.

The tale of the British car driver's woes is completed by the statement that 7.8 per cent of them are caused by failure of the brakes, of the suspension, and of the wheels themselves, as distinct from axles, etc.; while the remaining 5.1 per cent are laid at the door of the front axle and the steering gear.

THE SCIENTIFIC AMERICAN, July 30, 1921. Volume 125, Number 5. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday, July 30, 1921
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class matter. Trade Mark Registered in the United States Patent Office.

On the Trail of the News

DECEMBER 24, 1814, saw the signing of the Treaty of Ghent, bringing to an end the farcical conflict known in this country as the War of 1812, and having hardly a name of its own to distinguish it in the British mind from the generality of the Napoleonic Wars. On January 8, 1815, fifteen days after the diplomats had reached agreement on the questions at issue, the most spectacular land battle of the war was fought at New Orleans. Presumably, had there been any way of doing so, the respective governments would have notified Generals Jackson and Pakenham of a state of armistice. But the contending armies were not alone in their ignorance of passing events; the public of Britain and America were in equal darkness.

The events of July 2, 1921, at and around Thirty Acres, Jersey City, afford a striking contrast. The sporting interest always inherent in a championship contest of any sort reaches its culmination in a heavyweight boxing match. In the bargain there was the international character of the Dempsey-Carpentier melee, which was further heightened by the exuberance with which the entire French nation threw itself into the business of rooting for its champion. Finally, the bout possessed a sentimental attraction never before seen in such an event, by reason of the general feeling against Dempsey and for Carpentier on the ground of their respective war records.

Under these circumstances it is not surprising that the news-gathering agencies were ready to outdo themselves in their efforts to report the bout fully and swiftly. A brief catalogue of the instrumentalities employed in this service will be illuminating. First place must go to the wireless telephone. A complete "punch by punch" summary of the fight was sent over the ether from the arena, so that anybody, anywhere, within a range of many hundreds of miles, needed only a receiving set to keep himself better informed of the progress of the fight than the occupants of the more remote seats. For those lacking such sets, or lacking the ability to use them, there were, in every large town and in hundreds of small ones, bulletin boards on a more or less ambitious scale on which the telephonic reports were posted. Columbia, Pa., is by no means a metropolis, yet in driving through this town on the afternoon of the fight we paused to watch, on such a board, what proved to be the final round. The French craving for the fullest and promptest account was satisfied by wireless and cable; and in the bargain the large photographic agencies at the ringside made duplicate exposures, and delivered one set of undeveloped negatives, by airplane, aboard a ship that had sailed from New York four hours before the first punch—thus avoiding a wait of two days or more. A British illustrated journal arranged for the transmission of pictures of the critical moments of the fight, using the cables in connection with the well-known half-tone analysis of the original. We are not at the moment informed of the operative details or the extent to which the scheme was successful, but there is of course no reason why it should not give satisfaction. Finally, there was the usual army of special correspondents, equipped with telegraph and telephone, and charged with the thankless duty of getting every move over the wire before it happened. In this connection it may be in order to mention one of our good friends who has been reporting the World's Series baseball games for his organization for fifteen years, and who is so good at this business of getting the play on the wire while it is being made that in cities where there are adjoining bulletins, one fed from his wire and one from a competing service, he is always five seconds or more ahead of the other fellow.

It seems at first blush a trifle deplorable that such marvelous reportorial ingenuity and skill should be lavished mainly on sporting events. The answer is after all reassuring. Sporting events come off on schedule; wars and fires and murders and wrecks do not. If they did, we might be sure that the same means employed in the filling of the sporting pages and the flashing of the sporting bulletins would be employed with equal freedom on the world's more serious business. To whatever extent they are applicable they are so employed; and the methods themselves are a great tribute to the enterprise as well as to the technical skill of the present generation.

Doing Instead of Talking

THE literature that has been devoted to lamenting the waste of power resources in the shape of coal, oil and gas, and to pointing out how this waste might be prevented would easily paper the walls of all the buildings in the United States. What is perhaps more to the point, the paper that has been wasted in unheeded sermons on the subject of fuel economy would, if stoked under steam boilers, go a long way toward relieving the present alarming shortage of mechanical power throughout the world.

During the last four years the price of coal has more than doubled in this country. During the same period an immense amount of publicity has been given to methods whereby a stated amount of coal can be made to yield more power and other service. The general application of these methods would have mitigated the burden arising from the increase in coal price, or, more probably, it would have diminished the demand for coal to such an extent as to prevent any material increase in prices. Unfortunately nothing of the sort has happened. Intelligent economies in the use of coal are still the exception. Colossal waste is still the rule.

How long is this paradox to continue? How soon shall we stop preaching fuel economy and begin practicing it? Cheap mechanical power is the greatest material need of the human race at this moment. It would set to work the idle factories and the millions of idle laborers. It would abolish the high cost of living. And it is perfectly attainable by the application of knowledge now in the possession of engineers.

Here and there pioneers have set the example which all must eventually follow. Two or three coal mines have been equipped to distribute their output in the shape of electricity instead of coal. Why are there not such mines in all parts of the country where deposits of coal occur within a couple of hundred miles of a profitable market for power? The present practice of shipping coal from a mine by rail to points within range of electrical transmission is the height of grotesque absurdity. A coal mine is exactly as logical a place to generate electricity as a waterfall. The intervention of the railroads, with their high freight rates and notoriously inadequate service, is the greatest single factor in making electrical power expensive. The erection, on a general scale, of central power plants at the mouths of coal mines is capable of revolutionizing the industrial life of this country.

What is true of electricity is likewise true of gas. The natural gas industry has fully developed the technique of distributing gas to points hundreds of miles distant from the place of production. Now that the supply of natural gas is on the verge of exhaustion it is high time for the coal mines to take up the task of the expiring gas wells; to generate gas at the mine mouth, and supply it for industrial and domestic use in the surrounding regions. Here again is an opportunity for the coal operators to serve their country and their own pocketbooks at one and the same time.

Prevailing methods of burning coal are a full generation behind sound theories on the subject. It appears to be well established that vast economies both in labor and heat units can be effected by reducing coal to a pulverized or so-called "atomized" form before it is burned. It is encouraging to learn that fifteen million tons of coal was pulverized in the United States last year. But it is discouraging to reflect that this amount was less than three per cent of the total coal production of the country.

The Paradox of Civilization

IF we ask whether a man can be over-civilized, the answer depends, no doubt, largely upon the bias of the individual passing judgment. Still more, however, it depends on circumstance. Over-civilized—over-civilized for what? A bookkeeper in a New York office is a very useful member of society. He is probably the last man against whom any of us would bring the accusation which we are discussing. But let chance—a shipwreck for example—completely isolate him from his fellows, and in most cases he will be quite unable to meet the new situation, which to a savage in the jungle might present no particularly difficult problems.

This is the paradox of civilization: that the more perfect, the more refined the methods employed by man to wage the struggle for existence, the more helpless does the isolated individual become. Think only how embarrassed you would be, especially on the advent of winter, if you should be unable to procure so simple a thing as a match. This, of course, is the time-honored lesson of all Robinsonades, but it is worth while to give it another thought in this year of grace 1921. For it exemplifies certain significant biological facts and principles. The record in the rock tells us how the races that have succumbed in the struggle and have passed from the face of the earth are not so much the simple, lowly, imperfect forms, but in many cases represent the last, seemingly most perfect link in an ascending chain of progeny. The grounds for this may be sought in a variety of circumstances. Some biologists incline to the view that the development of a race is determined almost wholly by inherent tendencies; that the race is born, grows to a certain form, and ultimately ages and dies, much as is the case with the individual.

But another view equally competent to account for the facts, is that the races of organisms became, through a process of survival of the fittest (out of a varied assortment of progeny presented for selection) more and more adapted to existing circumstances, which thus molded the surviving species of the period, as we see them in life about us, or as they have been preserved for us in the fossils of the age.

And, as long as the circumstances thus molding the plant and animal population of this globe remained approximately constant, all was well; the molding process continued in the same direction toward ever more perfect adaptation to existing conditions. But suddenly (geologically speaking) came a change, in climate or in some other condition closely bearing upon life. It was then as if the course of the runners in a race had been suddenly reversed, the first becoming last, and the last finding themselves now in the lead. For adaptation is a relative term. In proportion as a species had become highly adapted to the long-continued old order of things, in like proportion was it unfitted to conform to changed circumstance. Nature has her own way of condemning the over-conservative, and, in her characteristic pitiless fashion, she punishes failure with annihilation.

Can man be over-civilized?

In the recent past the evolution of our race has been not so much the development of the individual as that of society, of the organization of men and machines, which work in unison to maintain our complex modern industrial life. The individual, today, is probably little different, anatomically and physiologically, from what he was five thousand years ago. But the social organism is radically changed. Evolution has proceeded, in this respect, at a speed which mocks all comparison with any of her previous performances.

But let man beware! The time of his prosperity is his hour of danger! Take stock and count the cost! We have been living on our capital. A few hundred, or at most a few thousand years, and our dwindling coal supply will be wholly spent. When that day comes, the barbarian, the savage (if such there be), innocent, and therefore independent of our "modern improvements," may lead in the death race with the ebbing tide.

Unless—unless man proves the exception to the biological rule; as he may. For what species, in all the world's long history, foresaw the danger a thousand years before its onset?

Electricity

Prof. F. B. Crocker.—It is with deep sorrow that we have to note the passing away of Prof. Francis Bacon Crocker, founder and Vice-President of the Crocker-Wheeler Electric Company at Ampere, N. J., and for many years head of the Department of Electrical Engineering at Columbia University. Prof. Crocker, who was unmarried, was sixty years of age.

Basalt as Electrical Insulator.—Research made during the last few years has shown that basalt, which has a very good insulating property, can be practically cast. It can thus be employed for the manufacture of insulators possessing distinct advantages over those made of glass or porcelain. The enormous dielectric resistance of basalt points to extensive use of such insulators in the applications of electricity.

Mercury Vapor Rectifying Valves, according to H. Giroz, writing in *Revue Generale de l'Electricite*, possess a well-known ability to rectify currents. The high intensity mercury vapor valve, however, which is capable of coping with an output of from 200 to 1000 amperes per valve, is not yet of general use in electrical practice. It is almost certain that the mercury vapor rectifying valve will be put to considerable use in the no distant future, even in large units.

With a One-Meter Loop Antenna and a special twelve-tube receiving set, remarkable results have been obtained of late in Paris. Even transmitters of low power have been heard some 5000 miles away under conditions by no means ideal. In fact, messages have been recorded on photographic tape at times when commercial radio companies were greatly troubled with static. The twelve tubes employed for the receiver serve to detect, amplify and even filter the signals so that static and other parasitic disturbances are weeded out.

Aluminum for Electric Bus Bars.—A British aluminum company has just issued literature dealing with the use of aluminum for bus bars and interconnections in electric power stations, in which it claims that aluminum secures a more complete economy than the substitution of bare copper rod or bar for insulated cable. It claims that the use of aluminum results in considerably reduced initial costs, greater ease in erection, smaller temperature rise for equal inductance, and less weight; also slower temperature rise under temporary heavy increases of load and greater resistance to corrosion.

Large Mercury-Vapor Rectifiers.—After discussing the electrical arrangements of large mercury-vapor rectifiers, a German writer in a German periodical refers to the advantages of this type of rectifier and especially its high efficiency. He also refers to the satisfactory experience with the mercury-vapor rectifier, which demonstrates that the modern type in which the earlier defects have been eliminated is as certain in working as all other types of rectifiers. Furthermore, the mercury-vapor rectifier possesses quite a number of valuable characteristics which seem to render it superior to the usual type of rotary converter. It is believed that there is a brilliant future for this form of electrical equipment.

Four-Electrode Vacuum Tube.—In a recent paper by Prof. J. A. Flemming, read before the Wireless Society of London, there is described the new Flemming four-electrode tube which can be used as a detector of damped or continuous waves. In these tubes, instead of a grid intercepting the stream of electrons from the cathode there are provided two "potential plates," one on each side, which deflect the stream when their potential is altered by a received oscillation. This causes a variation of the thermionic current which, in the case of damped trains of waves, is audible in a telephone. In the case of continuous waves, this reduction of current can be made to cause a delicate relay to drop off while the waves are being received.

A New Arc System of Welding is now being employed by several companies who report that it effects maximum savings in the cost and time of manufacture and repair of metal parts. Uniform success is said to attend the welding of metals of various characteristics, such as cast, malleable and wrought iron, cast and rolled steel, bronze and brass, etc. The new system is the only one, so it is claimed, producing constant heat per unit area in the weld due to the following points: 1. A limited low voltage output from the generator which prevents injury from high voltage and assures a short arc. 2. Maintained constant current supply to the welder. The current flowing through the electrode is the same whether the current is short-circuited or flowing in the form of an electric arc. 3. Welding metals so designed that they furnish the required ductibility and tensile strength within practical limits of metallurgy.

Science

MacMillan Starts for Arctic Regions.—Donald B. MacMillan started as arranged for, for the Arctic regions in the small schooner "Bowdoin" on July 16 from Wiscasset, Me.

News Print From Waste.—A paper mill approaching completion in Chicago is to manufacture newsprint from waste paper under an entirely new process. The mill is expected to produce from 10,000 to 15,000 tons of newsprint annually.

Cleaner Money Coming.—The Secretary of the Treasury promises that soon cleaner money will be in circulation. This is devoutly to be wished for, as the dirty, insanitary, ill-smelling money which has been in use for the last five years has been disgraceful. Of course the fault does not lie with the government officials, as the Bureau of Engraving and Printing is not elastic, and has been greatly overburdened in the production of bonds and other public debt securities.

Shark Fisheries.—The fins are usually sold for consumption by Chinese but we have ourselves eaten shark fins "Newburg" which was a delicious dish. Each liver gives about a gallon of oil and is used as a preservative for leather and for a vehicle for paint. The meat is used for chicken-feed or as a fertilizer and the skins afford a source for aquatic leather. Shark steaks are sometimes served in the Chinese quarters of our Pacific Coast City under the name, if name is given at all, of "grayfish."

Ban on the Poppy.—The bright red poppies of Flanders fields are not welcome in Massachusetts. The Commissioner of Agriculture, Arthur W. Gilbert, in urging that no more seeds or plants of this variety be brought to this state for propagation purposes, asserted that the growing of the flowers here might result in tremendous loss in agricultural districts. The Flanders poppy, according to the Commissioner, spreads very rapidly, the seeds being carried by the wind, and there would be great danger of damage to crops.

St. Swithin Discredited.—The recent deluge of rain which was so welcome hereabouts has brought up the old story of the traditional forty days of rain which should ensue, but unfortunately this old saw is not a very reliable one. In the first place St. Swithin was not a saint at all, having never been canonized. He was only a plain bishop of Manchester from 852 to 862. The weather bureau statistics also show that in many cases St. Swithin can only be credited with nine days' rain instead of the regulation 40 days.

Japanese Beetles Imported to Destroy Insects.—Five thousand beetles have been imported from Japan to fight a pest of destructive leaf-eating beetles in the Eastern States where they have done great damage to truck gardens. The beetles which have been imported are of a particularly ferocious variety and it is expected that they will make short work of our domestic beetles which are so destructive to the crops. This particular beetle has been shipped to the United States before, but never in very large numbers. It is expected that a much larger shipment will be made in the near future.

Longevity of the Eiffel Tower.—M. Eiffel, who is now 89 years old has a small apartment on the highest platform of the tower which he built, so that he has been comparatively free from the discomfort caused by the recent heat waves which the Parisians have not been enjoying. Every precaution is taken to prevent rust and M. Eiffel considers that the structure has a practically indefinite life. The Eiffel tower was erected over thirty years ago at a cost of $1,800,000. This remarkable structure was built in 25 months and weighs 15,000,000 pounds. There are more than 15,000 separate pieces in the tower which are held together by 2,500,000 rivets. Of course, the tower could not be built today for several times this amount.

Paying Fines As You Go.—Some useful things have occasionally come out of the turmoil in Central Europe. One of the best plans of which we have heard is a new fining system which is used in Prague. The police carry receipts for fines for various sums in their pockets, and present them for immediate payment to hilarious citizens who break the peace by singing or playing on musical instruments on the streets at the wrong time, or where the volume of harmony is too great. This tends to allow the citizens of this old city to get some much needed rest. This system has worked so well and has become so popular that it was extended to traffic violations as well. It would certainly be a great convenience if we could adjust minor infractions such as a smoking automobile, our failure to keep automobile lamps lighted, without having recourse to the police or traffic courts.

Engineering

Concrete House Building in Australia.—The use of concrete in cottage building was recently successfully introduced in Sydney, when it was demonstrated that a better construction, at a cost 25 per cent cheaper than brickwork, could be obtained. It is believed that the uses to which concrete may be advantageously put in Australia are manifold, if cement can be plentifully obtained.

Tidal Power.—In a recent issue of *Engineer*, there appears an analysis of the various methods of using tidal power, in which the author, Norman Davey, considers: (1) Single basin systems subdivided into (*a*) outward flow type, (*b*) inward flow type, (*c*) outward and inward flow type; and (2) two-basin systems consisting of (*a*) double basin type, (*b*) sump type. All these systems are of the water storage type. The float system is dismissed as having only theoretical interest, being a producer of small power only.

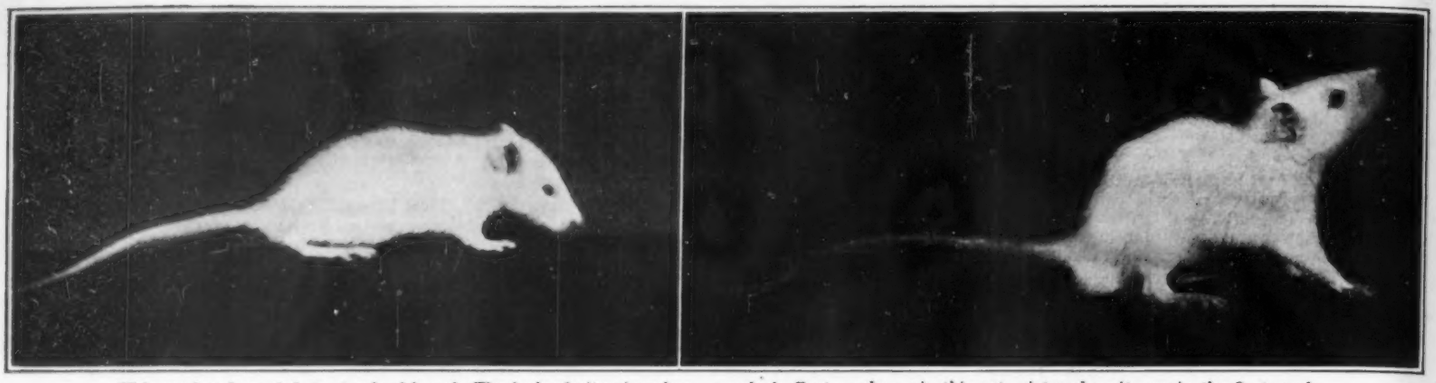
German Nickel-Chrome Steel Bridge.—From the *Krupp' sche Monatshefte* it is learned that the Germans constructed a bridge of nickel-chrome steel instead of mild steel, some nine years ago. This bridge has been in constant use and has proved satisfactory, no repairs having been necessary. The nickel-chrome steel used has thus fulfilled expectations, and proved to be a suitable material in cases in which low weight without loss of safety is essential. The bridge is a single-track railroad bridge, the main girders, which are of nickel-chrome steel, weighing 35 per cent less than if mild steel had been used.

A Movable Dam is a feature of the hydro-electric installation at Boffeto to supply electrical energy to factories at Sesto near Milan, in Italy. This dam, we learn from *La Vie Technique et Industrielle*, does not alter the bed of the River Adda, and ensures at the same time in a safe and rapid manner the passage of torrential floods, which are particularly swift and violent in this district. One or more sections of the dam can be raised or lowered individually as required, according to the state of the river; but in case of an unforseen flood the entire barrier can, by a system of racks and capstans, be raised simultaneously.

New Passenger Landing Stage.—The Port of London authority, the city department which owns and controls most of the London docks, has announced the prospective construction at Tilbury of an ocean passenger landing stage. This is to be of the floating type, 1700 feet long, 80 feet wide, and 40 feet deep below low water ordinary spring tides, so that the largest vessel afloat can be accommodated alongside at all stages of the tide. It will be equipped with the most up-to-date appliances for the handling of passengers' luggage, and customs examination will take place in a hall which will be constructed alongside. The landing stage will be connected by a bridge to the railway station.

Power from Glacier.—On account of the scarcity of water power in the Bern district of Switzerland, it is proposed to utilize the water from the glaciers in a systematic manner. The Bachilis Glacier is the first one selected; and by closing the natural drainage and constructing a masonry dam, the engineers are to form a storage reservoir of 113,000,000 cubic feet capacity. Water will then flow from the reservoir to Lake Grimel, which upon the completion of the new dam 492 feet long, 325 feet high by 262 feet wide at the base and 12 feet 6 inches wide at the top, becomes the main storage basin for the entire installation. Two new power stations are to be constructed, developing 120,000 horsepower in one and 90,000 horsepower in the other.

Canalization of the Rhine.—Under the Treaty of Versailles, France is granted the exclusive right of the exploitation of the Rhine from Bâle to Lauterburg, and she claims to dispose of the river as she would of any purely French waterway such as the Rhone, the Loire, etc. That portion between Bâle and Strasbourg, we learn from *The Technical Review*, it is proposed to sacrifice as a navigable waterway and to substitute a canal some 80 miles long with numerous locks. The aim is said to be to favor exclusively the Alsatian-French canal system, the Atlantic and Mediterranean ports of France, the agriculture of Alsace (through irrigation from the Rhine) and Alsatian-French industry (through hydropower stations to be established on the closed part of the Rhine). An engineer has entered a plea for the abandonment of this scheme, showing how the canal would seriously limit the tonnage reaching Bâle, involving the transfer of cargo from ships to barges for the passage of the canal. He claims that the required water power could be obtained without closing the river.



This rat has been fed on standard bread. The lack of vitamines has a marked effect as shown in this rat, pictured as it was in the first week and then in the ninth week

What Are Vitamines?

Studies and Experiments Which Cast Some Light on These Mysterious Elements of Nutrition

By Harry A. Mount

ONLY in the rarest instances has human life endured beyond the century mark, and the hope that we shall ever be able appreciably to lengthen the maximum span of existence seems somewhat chimerical. But a series of recent experiments holds the rather definite promise that such a thing is not impossible, and that we may be enabled to wage such a successful fight against old age that a man will still be "young" and virile at a hundred. The agency which promises this miracle is the mysterious food element which scientists have named "vitamines."

Another remarkable group of experiments is being conducted at the Rockefeller Institute for Medical Research and elsewhere, as described in a recent issue of this journal, which forms the basis for the conclusion that the tissues of the human body are potentially immortal; or, putting it another way, that barring accidents and disease we ought to live forever.

The reason we do not actually live forever is that the organs which compose the complex human mechanism are interdependent, and failure in one, even a minor organ, induces failure in others. As time goes on there is produced the phenomenon which we have come to associate with old age, and finally death.

It seems that medical science has pretty well accepted the conclusion that the physical wellbeing of many of these organs is controlled by certain glands, which have been merely disregarded heretofore because their function was not understood. These new experiments indicate that the action of the glands, and consequently many bodily functions, depend in part or entirely upon an element of food, which, although it has not yet been isolated, has been arbitrarily named vitamines.

The case against vitamines might well be first considered, for it is based upon the fact that they are mysterious. No one has ever seen a vitamine; the existence of vitamines has only been surmised from the very definite effects upon the animal organism when lavishly fed with vitamines and when deprived of them.

It is a historical fact that men, in their search for new agents which would protect or extend life, have often attributed marvelous curative powers to the mysterious. This was not only true of ancient and medieval times when witchcraft and sorcery were thought to be at once the cause and cure of disease, but also in modern times. It was not so long ago that the subject of medical electricity was much discussed and marvelous things were predicted. Electricity has proved very useful and its medical field is being constantly extended, but the hopes of these early experimenters have not been realized. So with radium and other curative agents. We ought to be warned in advance, then not to be too hopeful of what the exploration of this new field will reveal.

Vitamines are the elements in food which are apparently vital to certain functions of the body, necessary to human—or animal—existence. Hence the name.

The existence of vitamines was first definitely established during the Russo-Japanese War. Large numbers of Japanese troops, subsisting largely on a diet of polished rice, developed a disease called beriberi, similar to scurvy. Considerable experimentation showed that an effective remedy was the feeding of a small quantity of the rice polishings. From this it was inferred that there was some vital element in the surface of the rice grain. Further experiment showed this vital food element to be present in many other foods, in a greater or less degree, and, in the case of fruits, vegetables and grains, nearly always on the surface or skin. Thus the bran of wheat, the peel of an orange, and the skin of a potato, are rich in vitamines.

It has not been possible to isolate positively these vitamines, and their chemical composition is unknown. It has been possible, however, to prepare concentrates very rich in vitamines and to prepare other foods almost wholly lacking in them. By feeding these to various animals and noting the effects, we have succeeded to some extent in furthering our knowledge.

Thus a mouse, given a normal diet but deprived of vitamines, gradually looses its sleek appearance and weight. Certain of the organs, notably the glands, decrease in size and the very nature of the animal changes. A condition of perfect health and vigor can be restored in a few days, however, upon the identical diet, but with the addition of a very small quantity of vitamines.

It appears from many experiments along this line that the vitamine bears an intimate relation to the secretive glands of the body, and that these glands, in turn, exercise a decided effect on all the bodily functions.

Recently the world has been startled by the statement of a French scientist that he has succeeded in revitalizing an old man by replacing certain glands with those taken from a young and vigorous animal. A few weeks ago a Washington scientist stated that he had obtained a similar result by stimulating the glands to renewed activity by the application of electrical rays. Still more startling is the claim of another Frenchman to the effect that he has been enabled to change the sex of animals by depriving them of certain food elements, causing the sexual glands and organs to disappear and then, by proper feeding, to cause them to reappear.

These things seem quite unreal and impossible to the average person, because they are so far beyond the range of ordinary experience. We cannot vouch for these statements, true; but there is undoubtedly some basis of fact. At least, there is a growing conviction among scientists that the glands play a more important part in our earthly existence than we have supposed. Recently medical men of high reputation have advanced the theory that the appendix, long considered merely troublesome and useless, is a gland with important functions.

It has been possible, in tests with animals, to accelerate or retard the growth and vigor of any of the glands at will, with very marked results to the whole body. From these experiments the vitamines have been divided into three classes called Vitamines A, B, and C. Vitamine A is a fat soluble, such as is obtained from milk, and is remarkable for its effect on the growth and vitality of the sexual glands. Vitamine B is a water soluble, such as is obtained from green vegetables, and appears to be closely associated with growth, especially in young animals. Vitamine C is also a water soluble such as comes from oranges and lemons, and seems to be concerned especially with keeping adult tissues in healthy condition.

(*Continued on page 87*)

This rat has been fed on bread containing a large measure of yeast. Note the "before" and "after" effects, with nine weeks elapsing between the photographs

Learning the Truth About Arches

By George H. Dacy

IN the technical language of the scientific engineer and construction expert, an arch is ordinarily designated as a statically indeterminate structure of the third degree. Arches are vitally affected by the live loads and heavy burdens to which they are subjected, while in many instances they owe abrupt or gradual deterioration to radical and frequent changes in the temperature and to the settlement of their foundations.

For the most part, little definite data have ever been collected and compiled relative to the deflections which various arches develop under different stress, strain and load. The Austrian Society of Engineers in 1895 conducted the initial series of investigations and studies of the deflections of arches. They experimented with a wide range of arches from short-span brick models to arches that were 75 feet in length, placing extremely heavy loads at various points on the different arches and continuing to increase the load until the arch would fracture or collapse. In every case they measured the vertical deflection of the arch each time after the load was moved or increased. Remarkably valuable results were obtained from this research work to the ultimate improvement of arch construction.

Experimental arch and test weights at the University of Illinois, now being used to learn the truth about arch design and construction

Investigation now in progress at the engineering college of the University of Illinois, under the direct supervision of Professor C. A. Ellis, is the first attempt of any American institution or engineering society to throw more light on the intricacies and complexities of arch construction and design. These tests are more comprehensive than those attempted by the Austrians, and are to be continued over several years until all possible facts, figures and technical information regarding arches are obtained. At this writing, the first experimental arch at the middle-western university is being tested. It has been built on the campus near the engineering buildings. It is a 30-foot span arch with a 6-foot rise and is 3 feet thick. It is of reinforced concrete construction, being 6 inches thick at the crown and 15 inches thick at the abutments. It has been reenforced with ten half-inch square rods—five on the top and five at the bottom.

In testing out the strength, service and durability of this arch, the engineering experts make technical computations and ascertain the theoretical stresses and strains which the arch should sustain. Then they make practical application of these theoretical facts. They are endeavoring to establish definitely the truth or fallacy of the three theoretical assumptions which long have been accepted as fundamentals by the engineering fraternity—that in the case of an arch under load: (1) There occurs no change in the length of the span, (2) no change obtains in the elevation of one support with reference to another, and (3) no rotary motion of either abutment ever results. If the practical results show definite deviations from these basic principles of arch construction, the experts are going to find out the cause and effect of such differences.

In building the concrete test arch, corks, which penetrated to the rod reenforcements, were set in the "green" concrete so that when the material set, these corks could be removed at the will of the engineers. Small and minutely uniform holes have been sunk at each of these points in the reenforcement. Special strain gages of extreme delicacy are used to measure the length of these holes when the arch is without load. Then, in turn, the loads are placed at various positions on the arch and, in each case, additional readings are made with the strain gages in order to check and estimate accurately any change in the length of these holes, that may result from the deflection—if any occurs—of the arch. Electrical thermo-couples are used to ascertain and record any rise of temperature which develops in the arch due to the strain which it experiences under load. Arrangements have been made so that temperature readings can be taken simultaneously at 45 different points in the arch. In case extreme rises of temperature are engendered by the introduction of excessive loads, the arch will hump up and buckle at the center and, perhaps, totally collapse.

The investigational arch is also under test for spreading and weakening of the abutments when the loads are increased and applied at different points. Delicate measurements are provided for by means of a graduated, horizontal rod encased in metal piping and set between the bases of the two abutments. There are five points on the arch where vertical deflection measurements are taken. As is shown clearly in the accompanying photograph, the loads, consisting of large slabs of concrete of standardized weight, are supported on tables at both ends of an 18-inch, steel I-beam. Two jacks are used to raise the beam and its burdens so that the weight of the concrete slabs is transferred to the arch.

The tests will be continued until the arch collapses. Then a new one will be constructed on the basis of the results obtained from the pioneer tests. The work will be repeated until the engineering authorities at the Illinois institution are satisfied that they have solved accurately and conclusively all the practical problems pertaining to arch construction and standardization. In particular, it is obvious enough that if the work is carried to a logical conclusion, it will lead to the definition of the optimum shape and style of construction for arches, and through this to material increase in economy and efficiency.

A Machine That Clears Away Land

By William Melas

THE increased demand for more land to be put in food crops necessitates the conversion of brush or woodland into agricultural fields. The process of reclaiming land took our forefathers years to accomplish and the progress made in clearing additional area has hardly kept pace with the growing population and demands for more food products.

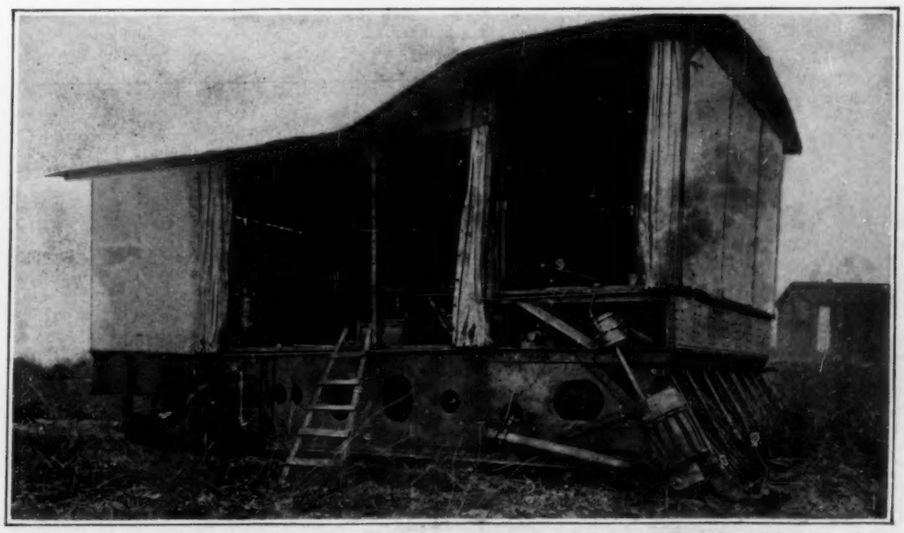
In recent years the question of reclaiming land has received the thought and energy of men in all parts of the country. One of the most striking illustrations of the advanced methods of doing this work is shown below in the view of a new machine which is decidedly out of the ordinary.

Like most modern agricultural machinery, this machine is propelled by caterpillar treads, smooth enough to prevent injury to roads. Along the front of the machine may be seen a number of bars having teeth cut at their lower ends. When the machine moves forward these bars alternately enter the ground, lacerating the roots and bringing them to the surface, where they are carried clear of the machine by the conveyor belt to be seen in the illustration.

At the back of the machine are two chains carrying sharpened prongs. These pulverize the surface and leave the soil ready for planting. The ground is broken up to a depth of 18 inches. The above operations are all performed at one passage of the machine.

A generator connected to the gasoline motor which propels the machine furnishes current for several floodlights so that work may be carried on at night.

The caterpillar treads are driven separately so that the machine may be easily steered. In recent demonstrations, stumps as large as 30 inches in diameter have been excavated. Depending upon the nature of the land, an average of three acres per day may be cleared with this machine at a saving of 60 per cent over the present-day methods.



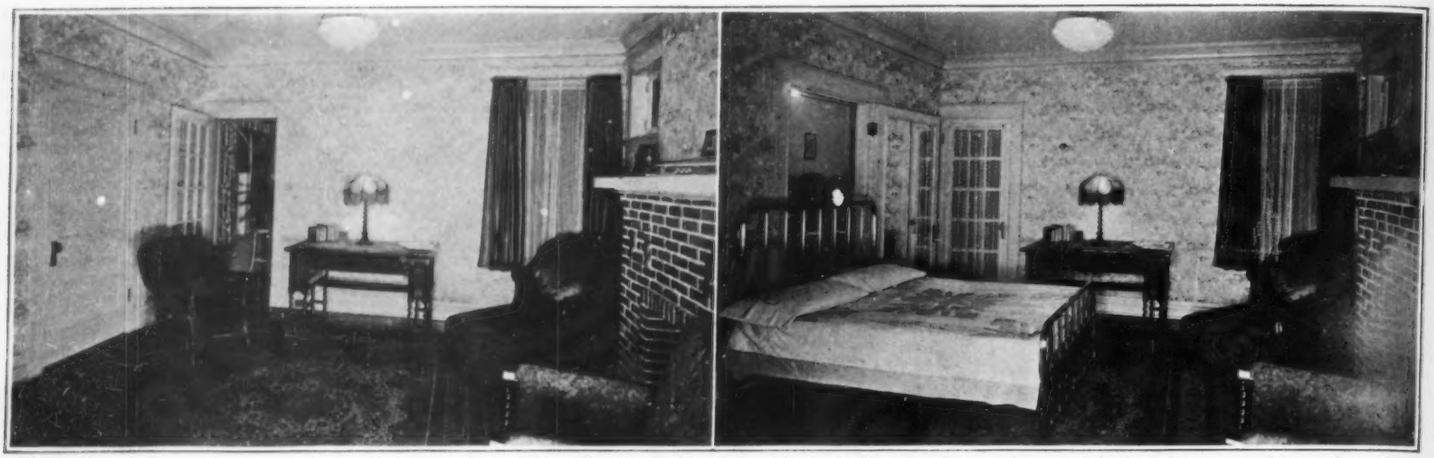
Under normal conditions this huge machine clears on an average of three acres of land per day at a far lower cost than the usual methods

New Varnish That Insulates

A NEW varnish possessing marked insulating properties has been recently placed on the market. According to tests made, the varnish after baking, possesses a high dielectric strength and electrical resistance, excellent binding and cementing qualities and is practically moisture, acid and alkaline proof. The varnish is not appreciably attacked by sulfuric acid, nitric acid, hydrochloric acid, caustic potash, ammonia, chlorine gas or iodine. The average of all samples tested showed that after 72 hours' immersion in water at a temperature of 80 degrees Fahr., the weight of the varnish film had increased by only 0.4 per cent. The 72-hour immersion showed no tendency to soften the varnish film.

The tests made covered the bending of films over a cylinder ¾-inch in diameter, and investigation of its penetrating power and the "stiffening" point and the "dust-free" point in baking and drying experiments and the "well-dry" and the "hard-dry" points in matter of time.

As an air-drying varnish, the report enumerates uses to which it is suitable, such as a preventive of corrosion and electrolysis of iron and steel and as a general finish on metal surfaces and a waterproofing material on wood, brick and concrete surfaces. As a matter of fact, no such catalogue as this should be necessary to make it plain that a varnish scoring a good showing in all the respects mentioned above will be of material commercial applicability.



The modern living room as seen during the day and at night. The big double bed, with the bedding in place, swings upright and then, on a pivot, swings into the closet

Home Building Simplified

What Inventors Are Doing by Way of Giving the Home Builder More House for Less Money

By M. A. Henry

A NEW YORK real estate operator was influenced by the active propaganda for relief from the housing shortage to attempt, not so long ago, to help in his small way to provide needed homes. He secured a tract of land desirably located, and erected on it a group of six-room houses. The houses were of substantial construction—not elaborate, but with pleasing detail—and were thoroughly modern; in short, they were just the sort of houses that the average American family longs for.

In due time they were finished and advertised. Many came to see them, but few bought. The operator was entirely at a loss to know the reason. The houses sold for $15,000 each, at only a fair profit over their cost; they were ideally suited to the average need; the people who came to see them appeared to be the sort of people he expected to find as customers. The operator agreed to carry a good portion of the cost on mortgage. What could be the trouble? He asked one of his prospective customers who had just decided "not to buy at this time," why the prospective customer had reached that decision.

The man took from his pocket an envelope on the back of which he had scratched some figures.

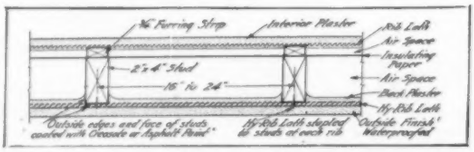
"There's the reason you can't sell your houses," he said. "Let me explain. In the first place, whether I pay cash or part cash, there is chargeable against my investment at least six per cent interest on $15,000. That is $900 a year. Then there are taxes, which at $2.81 per $100 on a valuation of $12,000 is $337.20. There is $25 insurance a year; $150 for coal, $200 for repairs, and figuring the life of the house at 20 years—it would be out-of-date and worth little then even if in good condition—the amortization charge each year is $750. Add it up. That's a yearly cost to me of $2,362.20—nearly $200 a month 'rent' or about $33 a room! I can't afford to pay $200 a month rent and I can't afford to buy that house."

And there's the whole "housing problem" in a nutshell, so far as the individual is concerned. The American family of which the prospective customer was the spokesman, six years ago would have thought they required a six-room house for comfortable existence. Now they live in "three rooms and bath," and like it! They have a feeling they ought to be paying for their own home instead of "enriching" a landlord like the rest of the sixty per cent of our population, and they are not quite weaned away from the good old days of low building costs.

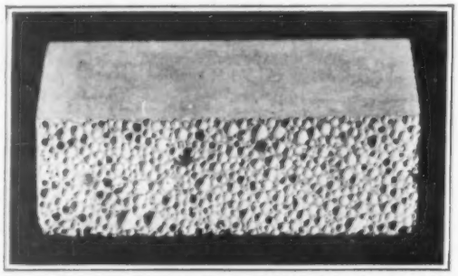
But, as a matter of fact, living conditions have undergone a revolution in the past few years. To be sure, there are fewer houses per unit of population than there used to be, and the result is that in many cases two or three families are living where one lived before. But the author doubts if we are any less comfortable: we are simply learning to use our home space more economically.

That state of affairs has led to a real challenge to inventive genius to produce devices which would utilize still more efficiently the space in a small home. Just as any challenge to ingenuity calls forth much wasted effort, so we have been deluged of late with countless housing schemes and devices. A few have stood the test. It is the purpose here to show how these are actually changing our former plan of daily existence.

Take the case of the man who could not afford a six-room home. He lives in a three-room apartment at just half the cost to him of owning his own home. And those three rooms do the duty of six, because no part of the home is allowed to be idle. There is a comfortable living room with a fireplace, with no hint throughout the day that the two doors at one side conceal twin beds. These beds—full sized, substantial



A form of wall construction which is recommended by the Bureau of Standards



Section of a porous cement slab that is used in much the same manner as wood for outside facings

Small cottages built at Oakland, California, with all manner of space-saving devices, in order to reduce costs to a minimum

and comfortable, fold into an upright position with the bed clothes in place, and swing on pivots into closets behind the doors. They are swung out again and lowered, ready for use, in a few seconds.

In the dining room another larger bed is concealed in another closet. The kitchen is smaller than our mothers were accustomed to, but is much more conveniently arranged and the housewife's work is considerably easier. There is no need for a servant. At one end of the kitchen is a built-in "Pullman" breakfast corner where breakfast and lunch are served at a great saving in labor. Father, mother and the children are just as comfortable as ever they were in a six-room house, and the housework is lessened by one-half.

The kitchen arrangement deserves special attention. The four-burner gas stove with its oven, the sink, ice chest, cupboards and drawers are all built of steel into one compact unit. Mother doesn't have to take a dozen steps to prepare a whole meal. She dumps the garbage into a chute that carries it outside the building.

And remember, this is not an isolated instance. Thousands of families in our large cities are living in "folding" homes because the same economic conditions which force individual families into smaller quarters, force owners to provide this sort of dwelling. If a man cannot rent an eight-room apartment or house at a profit, he cuts it into two four-room apartments and adds the equivalent of two rooms to each by the installation of clever built-in devices.

Many unique space-saving devices are now being used successfully. One would think, say, that it would be impossible to reduce the floor area occupied by a "man-sized" bath tub. But it has been done by making a deep well in one end of the tub, which is sunk beneath the floor. The bather then sits in an upright position, with the water around his shoulders, if he so desires. The deep basin is also useful for a foot bath or a small tub for the use of the children.

Even the lowly but essential ironing board is built into the wall. A long narrow door conceals a shallow alcove in which two ironing boards, a large and a small one, stand upright. The boards are ready for use simply by pulling them down into a horizontal position.

One maker of a famous ready-cut house has just placed on the market a small dwelling which embodies these features and others. Fully half of the furniture is "built in," including a breakfast corner, stove, icebox, cupboards window seats, folding beds, etc.

"What we are coming to," said William L. Murphy, perhaps the most successful inventor of space-saving devices, and head of a nationwide organization, "is actually a revolution of our ideas of what a home should be. And it has taken a mighty upheaval to bring this about. People are not easily turned away from the modes of living with which they have grown up.

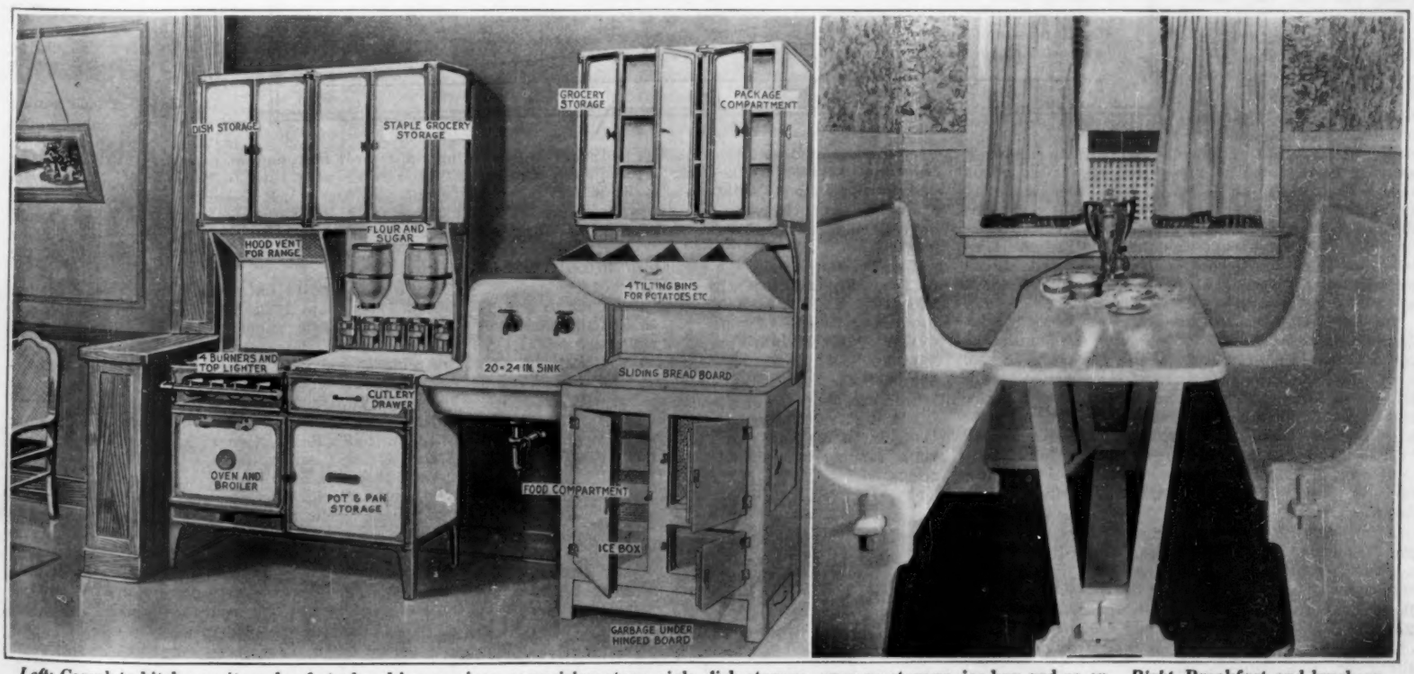
"The idea of the small house in which every inch of space is useful, originated, or at least first gained prominence, in California where the housing problem is least acute, notably in Los Angeles and later San Francisco. The idea has moved eastward steadily until it is just gripping the great centers of population in the East. Why this should have been I cannot explain. It simply happened that the people of the West were more receptive to new building ideas. Stucco, for instance, is just gaining prominence as a building material in the East, while in sections of California fully ninety per cent of the buildings are of stucco.

"But will people return

(*Continued on page 87*)

A form of construction that is steadily gaining favor: porous cement slabs during construction and as finished

Fabricated steel house made up of standardized panels, which sells at a low cost and can be added to at any time



Left: **Complete kitchen unit made of steel and in one piece, comprising stove, sink, dish storage, grocery storage, ice box and so on.** ***Right.*** **Breakfast and luncheon table and benches for the corner of the kitchen**

Tomorrow's Airships

A Survey of What Has Been Done in Commercial Aviation and Its Bearing on the Future

By Major George Whale, Late R.A.F.

THE present age is one of hustle in the endeavor to reconstruct prosperity after the devastating effects of what has been practically a World War. To the man of business, the saving of time means increased profits; and since most of such men spend a considerable portion of their working days in traveling, any means of reducing the hours occupied by their journeys, either over land or across the oceans, will be undoubtedly welcome.

It would appear that we have reached by now almost the maximum speed which can be accomplished over land by the express train, and across the sea by steamship. There is left only one other means of transport, and that is via air. The two forms of aircraft, the airship and the heavier-than-air machine, received an enormous impetus from the recognition of their value for war purposes, and reached a state of development in five years which would not have been achieved in twenty in times of peace. Undoubtedly a future exists for both types of aircraft in the realms of commerce, and it is anticipated that the time will come when the airship will usurp the functions of the fast-going ocean steamers, while the airplane will take over the traffic now borne by express trains and fast cross-channel boats. It will be seen, therefore, that the uses of the two types should not conflict, but that each will act as the complement of the other.

Until some entirely new design of airplane has been discovered, it seems fair to assume that no heavier-than-air machine is capable of undertaking non-stop flights over a distance exceeding 2000 miles, carrying any commercial load. On the other hand, as will be shown later, the airship exists today which can be transformed into a paying commercial proposition, and in addition, the transatlantic flight of the British airship "R-34" has proved that such flights will present no difficulty to an improved model of an airship of this type. By arguing on these lines, we may assume that for long distance flights over the oceans or vast tracts of broken and unpopulated country, the airship will be found to be the more suitable.

Up to the present time, although nearly three years have elapsed since the signing of the armistice, it is disappointing to read that very little progress has been made. In England a commercial airship company seems to be regarded as a new and highly hazardous undertaking. Various proposals have been made by a combine of the several firms which built rigid airships to the orders of the Government, to certain steamship companies to exploit the airship. The Air Ministry has been approached and is understood to be willing to lease certain of the service airships for a series of experimental passenger flights.

The Germans, thanks to the genius of the late Count Zeppelin, have been from the beginning the pioneers as far as the rigid airship is concerned. In the year 1910 a company styled the Deutsche Luftfahrt Actien Gesellschaft was formed to run a commercial Zeppelin service and proved singularly successful. Four vessels were utilized, namely, "Schwaben," "Victoria Luise," "Hansa" and "Sachsen." During the period 1910 to 1914 over 17,000 passengers were carried a total distance of over 100,000 miles without incurring a single fatal accident.

At the conclusion of the war a small airship called the "Bodensee" was designed and built with quite remarkable rapidity and not so very long ago a service was inaugurated between the Swiss frontier and Berlin. This airship, in comparison with the war-time Zeppelins, is much smaller, being only some 650,000 cubic feet against the 2 million cubic feet capacity of the latter. In design, too, she differs quite considerably, being much greater in diameter as compared with her length, while all outside surfaces such as fins, cars, etc., are more truly streamlined than was the practice in earlier ships.

Twenty-five passengers can be accommodated in the car and the journey is accomplished in comfort, hot meals being served en route. The scheduled time from Friederichshafen to Berlin was fixed originally at seven hours, but the journey in favorable weather has been accomplished in half that time. This service was maintained throughout the autumn months when the airship returned to the constructional station in order that an extra section of hull might be added to increase her capacity. It was intended that the "Bodensee" and a sister ship of similar design carry out a service during the summer by means of which Stockholm would be brought within much easier access of the German capital.

It seems reasonable to assume that if such success has attended an airship of small proportions, then infinitely greater results will accrue by building an airship of size. In the case of the British rigid airship "R-34," when sufficient petrol has been taken to render the transatlantic flight a safe undertaking, the margin of disposable lift available for passengers or merchandise is not enough to make such a trip a commercial proposition.

Fortunately for the airship, in contradiction to the airplane, the percentage of disposable lift increases with the size of the ship and the weight to power ratio decreases. In the airship the capacity, and therefore the gross lift, increases as the cube of the dimensions; so that a comparatively small increase in size is accompanied by an enormous gain in lift, while the resulting increase in the weight of the structure is nothing like proportional.

To give an example, the airship of 10,000,000 cubic feet capacity has five times the lift of the present 2,000,000 cubic feet capacity airship, but the length of the former is only 1.7 times greater and therefore the weight of the structure only five times greater $(1.7)^3$. Moreover the proportion of useful lift, that is, lift available for fuel, crew, passengers and merchandise, is well over 50 per cent when compared with gross lift.

Bearing these facts in mind the following table shows the gain in lift and slight increase in length for airships ranging between 2,000,000 and 10,000,000 cubic feet:

Capacity in cubic feet	Gross Lift in tons	Length in feet	Diameter in feet
2,000,000	60.7	643	79
3,000,000	91.1	736	90.4
4,000,000	121.4	810	99.5
5,000,000	151.8	872	107.2
6,000,000	182.2	927	113.9
7,000,000	212.5	976	119.9
8,000,000	242.8	1,021	125.5
9,000,000	273.3	1,061	130.4
10,000,000	303.6	1,100	135.1

A series of comparisons have been worked out from the performances of an airship of 2,000,000 cubic feet and those estimated for a vessel of 10,000,000 cubic feet, and are presented in the center panel.

From these figures it will be seen that the endurance and weight-carrying capacity of the rigid airship is merely a question of size. For the 10,000,000 cubic feet airship of the future the range is to almost all intents and purposes unlimited and the weight-carrying capacity large. Some 200 tons lift will be available for fuel passengers and freight and the endurance at cruising speed of 45 m.p.h. works out to approximately three weeks and the range to some 20,000 miles or nearly once round the world.

For the present, however, an airship of this size exists only in the imagination and it will be of greater interest to consider the commercial prospects of an airship already building. Air Commodore E. M. Maitland, C.M.G., D.S.O., R.A.F., the head of the British Airship Service, gave certain facts and figures in a lecture before the Royal Society of Arts in London a few months ago. These are particularly valuable as being the first which can be regarded in any way as official. The type of airship chosen for the occasion was "R-38" (now known as "ZR-2"), which has been purchased by the American Government and is nearing completion at her constructional station. Air Commodore Maitland chose an airship of this capacity since nobody could deny the possibility of building one of this size, although he had worked figures for a 4,000,000 cubic foot ship which gave still better results.

The "R-34" had a total volume of 2¾ million cubic feet. She could carry 15 tons for 50 hours at a continuous air speed of 60 m.p.h. The assumption was made that she would fly about 2500 hours in the year at an average ground speed of 45 m.p.h., although confidence was felt that the higher speed could be maintained. This would yield a yearly ground mileage of 112,000 miles and allowed the airship to be laid up for three months each year.

The cost of such a ship on war figures is £400,000 (about $1,450,000, but it is agreed that with standardization the price should be reduced to £200,000 (about $720,000).

The cost of a base station consisting of sheds, gas plant, workshops and landing rights over surrounding ground is £550,000 (about $1,980,000) or with shed to house one ship, £400,000 (about $1,440,000). A mooring base, equipped with mooring mast, gas plant and small stores, etc., would cost £45,000 (about $162,000). Five houses will allow services to be maintained between all parts of the British Empire.

The route proposed for working out the cost per ton mile is England to India via Cairo. In England and Cairo double sheds would be erected and in India a mooring station. Four airships would be working on this route, each flying 2500 hours, and with this arrangement a weekly service each way would be possible.

Each airship would carry 15 tons load for a journey of 50 hours. The flying time from England figures out as follows: To Egypt, 2 days; India, 4½ days; South Africa, 6 days; Australia, 9½ days.

Various figures have been given for the cost per ton-mile for an airplane service, and these seem to establish the fact that the airship is decidedly cheaper to exploit as a medium of transport. If the cost can be reduced, as Air Commodore Maitland asserts, to a much lower rate per ton-mile by building airships of 4,000,000 cubic feet capacity, passenger fares will be able to compete with steamship rates when the saving of time is taken into consideration.

A second scheme has been worked out in full detail for a proposed service between London and New York.

(*Continued on page 88*)

SOME DIRIGIBLE FIGURES OF THE PRESENT AND THE FUTURE

Performance	*2,000,000 Cu. Ft. Ship*	*10,000,000 Cu. Ft. Ship*
Gross lift	66.6 tons	303.6 tons
Disposable lift	38.8 tons	200 tons (approx)
Allowance for crew, water ballast etc.	11 tons	30 tons
Available lift for fuel and freight	27.8 tons	170 tons
Full speed (10% less than full power)	64.3 kts (74 mph) 1,800 H.P.	75 kts (86.3 mph) 6,000 H.P.
Petrol consumption/hr.	972 lbs (135 galls)	3,240 lbs (450 galls)
Oil consumption/hr.	97 lbs (11 galls)	324 lbs (36 galls)
Cruising speed (fast)	43 kts (51.8 mph) 790 H.P.	60 kts (69 mph) 3,700 H.P.
Petrol consumption/hr.	427 lbs (59 galls)	2,000 lbs (278 galls)
Oil consumption/hr.	43 lbs (5 galls)	200 lbs (22 galls)
Cruising speed (slow)	40 kts (46 mph) 610 H.P.	45 kts (51.8 mph) 1,800 H.P.
Petrol consumption/hr.	327 lbs (45 galls)	927 lbs (135 galls)
Oil consumption/hr.	33 lbs (4 galls)	97 lbs (11 galls)

Synthetic Agriculture

How Knowledge and Consideration of Every Factor Can Increase the Farmer's Return

By Henry Vendelmans, Agricultural Engineer

NO organized industry yields returns that are as widely different as those obtained in agriculture. If these differences could be accounted for by the varying qualities of land, they might seem natural; but they occur as well on land realizing similar conditions.

Moreover, the international statistics reveal that the average yield is low all over the world; besides a comparatively few good yields, by far the greater number are small.

These facts are most significant; and as all who are conversant with practical farming very well know, they must be ascribed to the unappropriated conditions of production. As a matter of fact, agriculture, which is a very difficult industry, requiring for its proper working a wider scientific knowledge than any other, is too often carried on in the most indifferent fashion.

Numerous experiments carried out in all countries have proved that practically no soil is rich enough to produce maximum crops, and various means of increasing production have been pointed to. Hence more intensive agriculture with higher yields, but yet here several factors that influence the crops were either not taken into account or were not given attention which they deserve; so that finally synthetic crop production was evolved which brings the possibility of the soil to its very limit.

It represents the most advanced stage of crop production, and is, after all, the only sound one. It is based on the knowledge of the various factors which influence the crops; it has the advantage of being applicable in all countries, whatever the prevailing conditions, because it takes them into account. They are the same everywhere although their value varies practically with every case, so that no easy general rule can be applied, but a previous investigation becomes necessary. This investigation bears not only on the soil, but also on the climate, local conditions, and the possible improvements. To this impfoved situation the most suitable crops are adapted, the soil being worked by the most suitable machinery and implements. This means a process of selection from beginning to end, which by its cumulative influence not only allows increased yields on good land, but also tends toward bringing the capacity of poor soil close to that of good soil and brings practically all waste land within the scope of reclamation. Although full results could hardly be expected from the first, they are very marked already and go on improving for perhaps three years until the limit of the possibility is reached. The successive improvements may lead to new possibilities in the shape of more valuable crops which become adaptable to the site. When this is accomplished, rotations as they now exist become obsolete and are abandoned in favor of such system of cropping that yields the highest return. One of the consequences is that wheat which has been held to be the staple crop is no longer necessarily considered such and very often will make room for better paying propositions.

In the following survey of the process which cannot possibly cover the whole matter, several interesting points are recorded.

Synthetic agriculture not only investigates into the composition of the soil, but also into its geological origin, which is often more important as giving information about the assimilability of the components; but whatever the composition be it is practically never considered rich enough in available feeding elements to supply the food for abundant crops; so sometimes the quantities of manures and chemicals supplemented are extraordinarily high in comparison with what used to be considered a liberal dressing.

For instance, on good land potatoes may receive sometimes, in addition to 8 to 10 tons of farm manure, as much as 10 to 12 cwt. of superphosphates, from 7 to 9 cwt. of potash salts, 6 to 7 cwt. of nitrate of soda, and so on. Pastures: 10 cwt. of basic slag, 4 to 6 cwt. of kainit, and 2 or 2½ cwt. of nitrate to the acre every year, according to the quantity of crops taken.

Also more attention is directed toward lime or chalk. In many a soil it gives exceptional results, thanks as much to its flocculating property, and the creation of an appropriate medium for favorable bacteria, as to the supplying of wanted food. The physical conditions of the soil and the subsoil are of far more consequence than they used to be considered. The coarseness or fineness of the particles affect to a great extent the availability of their contents, the power of retaining chemicals, water and fertilizing solutions, the development of roots, the aeration of the soil, its permeability, etc.; the proportion and quality of the humus. Humus is greatly responsible for the capacity of the soil for retaining moisture; probably as many crops are prevented from reaching full development from shortage of needful moisture as from a lack of food.

A good supply of humus yields a more favorable medium for aerobic bacterial life. Excess of humus keeps the soil unduly wet, cold and acid, and may be corrected by applying lime and aerating the soil. Practically 90 per cent of arable land is insufficiently provided with humus. Shortage of humus can be corrected by organic manures, green or otherwise. Sometimes no farm manure is produced, but even where it exists the quantity is quite unequal to the requirements of the land. Therefore recourse must be had to green manures; as a rule leguminosae are used. They are only exceptionally grown as main crops, but are constantly used as catch crops, either on the intercropping or the aftercropping principle. In synthetic agriculture they cannot be dispensed with altogether.

They not only act on the lines indicated above, but also enrich the soil in nitrogen, act favorably on the bacteria of nitrification, bring a good deal of water into the soil and darken its color. This latter point, although quite important, seems only to be appreciated by horticulturists.

(Continued on page 88)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Japan and a Big Navy

To the Editor of the SCIENTIFIC AMERICAN:

In the editorial column of your magazine of May 28, 1921, you take up the question of naval disarmament and urge that the United States economize because England has scrapped a large part of her navy. It is agreed that disarmament would be a good thing and we all hope that the day is not far distant when all forms of military equipment will be as far out of date as hoop-skirts, but there are a few important facts that we must not overlook before beating our swords into pruning hooks.

For instance, the naval appropriation of our little neighbor across the Pacific for 1921 is just about a half a billion yen. Now a yen is only equal to fifty cents in American money, but considering the difference in pay of Japanese and American seamen and ship-builders, it equals about two dollars. That brings their half a billion yen up to about a billion dollars against our proposed half a billion. You have correctly stated that naval strength is relative. How long will it be that we will have a relatively strong navy if we do not keep on the increase? So much for that.

Now, the question is what is Japan building such a navy for? She cannot afford such an expensive plaything one-tenth as much as we can. Surely the Chinese or Koreans are not going to jump on them. England and her colonies have no quarrel with Japan. Furthermore, there is a treaty between them. There is nothing that we want that belongs to the Japs. They know that we are not likely to attack them. Therefore, they know that they do not need a navy to defend themselves. There is only one answer left and that is they intend starting a war of their own. And their only possible opponent is the U. S. A. And Alaska and the Philippines are a prize worth going after. And after that the Hawaiian Islands and our own Pacific coast and an indemnity.

History has proven that a small navy is worse than no navy at all. It only sacrifices brave men and good material. A navy at the bottom of the sea should never have been built. Therefore, if we are to have a navy at all, we must have one that will overwhelm all possible enemies and do it easily. We must put economy out of our mind and think only of efficiency until that day dawns when we will all send our navies to the scrap heap.

And the one grand argument for world disarmament is to show the world that we are capable of building so much faster and better than they, that they will see the hopelessness of trying to compete and decide that the best plan is to agree to universal disarmament and arbitration of all international disputes. Not one man in a million would think of picking a quarrel with Jack Dempsey. But when Jack gets out of condition and goes back to a second rater, they will all be willing to take a crack at him.

Disagreeable as these facts are we must recognize them and act accordingly. And the only logical thing for us to do is to build such an overwhelmingly large navy that when the world conference for disarmament sits the offending nation will not dare to hold out against the rest of the world. If they are on anywhere near an equal footing there is a chance to quibble and refuse as she has done before. And what is more important still, if she refuses to see the hand-writing on the wall and insists in starting a war, we must be so thoroughly able to knock the rays from the sun of the Japanese battle flag that it will never appear on the horizon again.

I am surprised, indeed, that such an admirable paper as the SCIENTIFIC AMERICAN should fail to read the signs of the times. Instead of heckling the Senate into cutting down the Naval appropriation in order that the American people may have a little more money to spend on Fords, prize fights and moving pictures, it should urge the creation of a mighty armada and an overwhelming air force which are the only possible means of bringing about world peace.

History has proved that there is no other course possible. The surest way to provoke a quarrel is to be almost as good as the other fellow, or to even let the other fellow think he is as good as you are. Napoleon thought he could conquer the world and did, almost. Germany thought she could do the same thing and so nearly succeeded that there was no fun in it. Japan has evidently not learned her lesson and until she has, we must build, build, *build* until she sees the hopelessness and folly of her ways or else so punish her that she, like the kaiser, will no longer be a menace to the human race.

As a peace-living citizen, a Naval reservist, a veteran of the late war, a fairly heavy tax-payer and the father of a family which I hope will be able to grow up to manhood and womanhood and end their days without having to face the privation and hardships of another war, I have given deep study to the matter and try as I may, I can see no other solution to the world's most important question. F. P. ARCHER.

Wilkes-Barre, Pa.

P. S.—Upon second thought, I believe you printed that editorial just to start something. You have. Go ahead and publish the answers if there are not too many of them.

[*If our correspondent is right in his estimate of Japanese policies his point is well made. We think he is wrong.*—EDITOR.]

Why It Has Been So Hot

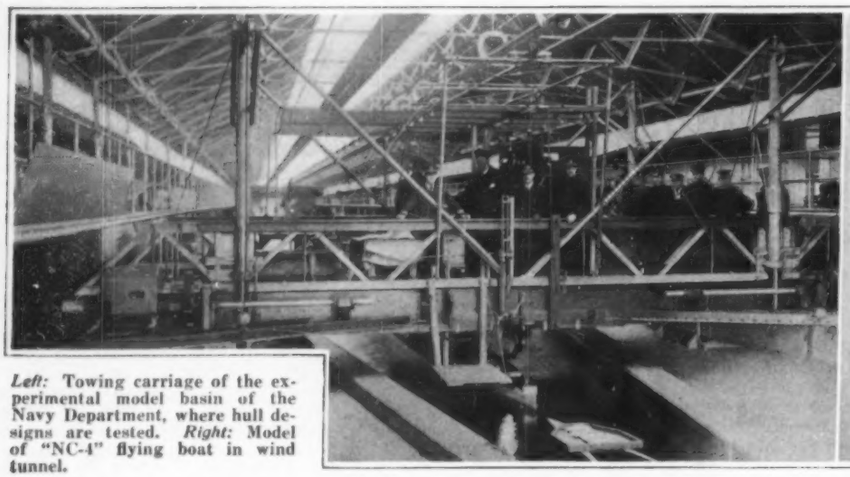
To the Editor of the SCIENTIFIC AMERICAN:

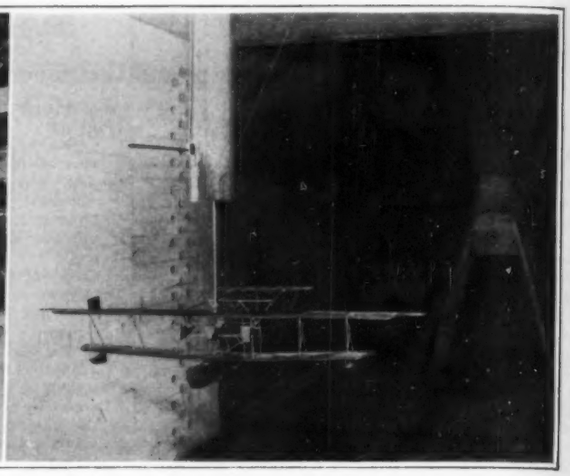
I enclose a weather prediction and statement of the cause of the extreme heat of the last few days, from the pen of our local weather prophet who furnishes forecasts for one of our dailies. This organ is supposed to be under fairly intelligent management, but evidently prints this yarn with complete faith in its authenticity. Its author views the solar system from the top of the ten-story newspaper building (in which he operates the elevator), and arrives at the remarkable conclusions set forth in the printed item. I read it with a mixture of interest and amusement which I hope may be shared by your readers. Here is what he says:

"It is likely that the whole solar system is passing through a zone of heat, as it sometimes does. Such heated zones are created by a nearer approach to some stars or sometimes by the combustion of a comet. There was an instance of the earth passing through such a zone in 1833, where the disintegration of a comet was believed to be the cause."

Let us trust that the solar system will soon get through the heated zone that it has encountered in space; and perhaps it is given to hope that it will not next run into a damp region of the universe that will result in excessive precipitation! J. S. C.

Battle Creek.





Left: Towing carriage of the experimental model basin of the Navy Department, where hull designs are tested. *Right:* Model of "NC-4" flying boat in wind tunnel.

With Model Basin and Wind-Tunnel

How Our Naval Constructors Check Up Their Designs by Means of Miniature Hulls and Model Airplanes

OUTSIDE of technical and shipbuilding circles there is not much known of an interesting establishment in Washington which has contributed in no small degree to the development of the American Navy during the last twenty years and to its success in the Great War. It is known as the Experimental Model Basin, and consists of a large laboratory where researches are made to determine, by making small wood models and towing them in a miniature ocean, the best form or shape for the under-water part of all naval vessels. It is possible in this manner to know long before a ship is built just how much power must be generated by the boilers and the engines to drive the ship at sea at its designed speed.

When it is considered that each of the great battle-cruisers, 850 feet in length, now building for the American Navy, will require 180,000 horsepower to make a speed of 33 knots or practically 38 land miles per hour, and that each will cost when completed and ready for battle about $36,000,000 the importance of the work done at this laboratory will be better understood. When a ship is said to require 180,000 horsepower it means that the strength and force of the machinery applied through the propellers to the water is as great as if it were drawn through the water at the top speed by 180,000 horses. If the resistance of the ship can be reduced by even one per cent, it means that the work which would require 1800 horses to do, can be saved.

In 1896, when the large expansion of the Navy began, the Navy Department obtained authority from Congress to build the Model Basin and to equip it for its important work in the construction of new ships. Before that time and until it was completed and put in operation in 1900, it was necessary for the Naval constructors to depend in the design of new ships, on experience with previous ships and on what they could learn from European testing basins, particularly from England where the method was first developed by Dr. William Froude. Without such a basin the American constructors were at a great disadvantage. Before this scientific method of ship design was introduced, from the days of the "Constitution" and other famous frigates down to the iron-clad vessels of the Civil War, they had shown themselves capable of designing as fast and powerful war ships as could be built by any other nation. So in building up a new and greater navy, a model basin was a necessity if America was not to lag behind its possible competitors in sea warfare.

To illustrate the saving in power made possible by the new methods, a comparison of the battleships "Connecticut" and "Michigan" may be given. The first was designed by the old methods and the second by the model basin method. These two vessels are of exactly the same length and displacement, but to make their designed speed of 18 knots the "Connecticut" requires 15,475 horsepower and the "Michigan" is obliged to use only 12,850. Moreover, the saving in the necessary weight of machinery was available for considerable increase in the weight of guns and armor, making the "Michigan" a more powerful fighting ship.

One of the accompanying illustrations shows the interior of the testing basin, which is 435 feet long, 42 feet wide, and 14 feet deep, all enclosed in a building to permit experiments being made in all kinds of weather. On either side of the basin are heavy steel rails on which runs a traveling crane, or towering carriage, driven by electric motors in a manner quite similar to a street car.

The models, twenty feet in length, are made of wood by expert model makers, as exact copies of the under-water part of the ship to be built. Another view on this page shows the model of a fast cruiser being finished by a model maker and inspected by the Naval constructor in charge of the Model Basin. When finished, the model is placed in the water, ballast added until its draft corresponds to that of the ship, and then put under the towing carriage to which it is attached by a spring scale which weighs the force required to pull it in the water at different speeds.

Fortunately, it is not necessary to pull the model at the same speed as the ship but at a much lower speed. Thus for a ship 500 feet in length to run at 20 knots it is necessary to tow a twenty-foot model only one-fifth as fast, or at 4 knots. Where the model has been tested at a number of different speeds, say from 1 to 4 knots, the corresponding resistance of the ship at speeds from 5 to 20 knots is readily found by taking into consideration the difference in weight or displacement between the two.

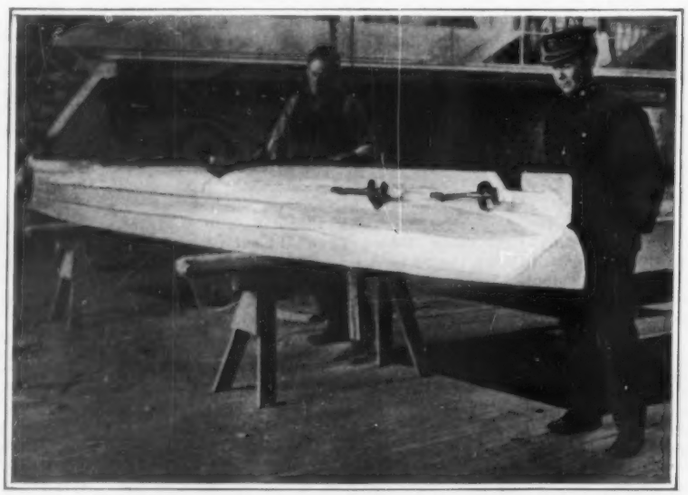
After the model resistance is measured, the propellers are put on the tiny shafts which are revolved by small electric motors so as to drive the model through the water. By measuring the horsepower taken by the motors and the speed of the model in the water and comparing this power with the resistance of the model as previously found, it is possible to know whether the propellers are of the proper size and form to be efficient when used on the full-sized ship. If the propellers do not work well, others are made and tested until good results are obtained. By these tests it is possible to know exactly how much power is needed for the ship and at what revolutions per minute the propeller will run.

The facilities of the testing basin are used to a large extent by private shipbuilding companies to test the models of merchant ships. For such test they are required to pay the actual cost to the Government—about $500 for each model tested.

The same principles used in testing ship models are also used for testing models of airplanes and dirigibles. To assist in the development of Naval aircraft the Navy Department in 1913 added a large wind tunnel to the laboratory equipment. The tunnel, which is the largest in the world, consists of a large air pipe, having a section eight feet by eight feet, through which the air is blown by a 500-horsepower motor-driven fan. A wind speed as high as 150 miles per hour may be obtained. In another view is shown the model of the seaplane "NC-4" in position inside the tunnel, ready for the test. The models are made 36 inches wide; that is to say, from one-eighth to one-fortieth as large as the full-sized airplane, depending on the magnitude of the finished machine.

By setting the model at different angles to the wind and weighing the lifting force and resistance of the model, it is possible for the constructors to compute in advance how much weight the airplane will carry and how much power will be required to drive it. Also, what is even more important for a flying machine, they can tell whether it will balance properly in the air and stay right side up. In the early development of airplanes many valuable lives were sacrificed because of lack of this quality, and quite aside from the ordinary engineering considerations of economy and efficient operation, this saving of skilled man-power is something well worth the cost of the wind tunnel, alike on engineering and on humanitarian grounds.

In the design and construction of the Navy seaplane "NC-4" the first aircraft to cross the Atlantic Ocean, careful model tests were made of models both in the wind tunnel and in the model basin to insure that the craft when built would do what was expected of it. The success of this design is ample evidence of the value of model tests of seaplanes. Incidentally, the seaplane, with the opportunity it gives to use wind tunnel and model basin in conjunction, presents a new combination in the experience of the engineer.



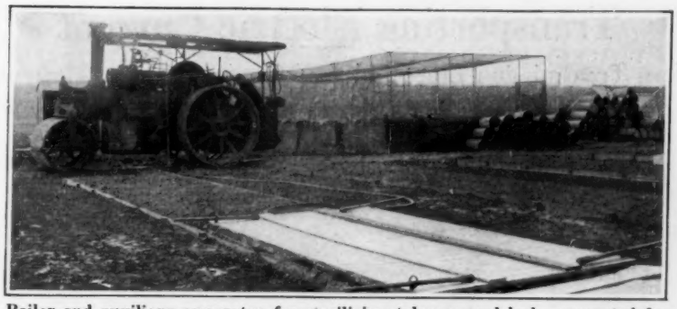
Applying the finishing touches to a model hull of a future battleship, under the supervision of naval constructor

Steaming the Tobacco Field

"BURNING plant-bed land" is a familiar phrase in the tobacco-growing areas of the South, where open fires are built on the plot of ground to destroy weeds and other extraneous growth before tobacco seeds are sown to produce seedlings for transplanting. The tobacco-producing district of the Connecticut Valley is replacing this method by a steaming process—an inverted pan is employed in driving steam into the soil.

The equipment used in sterilizing tobacco seed beds, thereby eliminating the practice of an intensive burning of brush and wood on the land, consists of: A portable boiler of 20-horsepower; heavy ¾-inch steam hose, 25 feet long; ¾-inch iron pipe long enough to convey the steam from the boiler to all portions of the seed beds; heavy canvas or burlap, 216 feet square; a steaming pan to cover an area of about 72 square feet.

The boiler is placed close to the bed, and the inverted pan is set on one end of a bed with its inlet nearest the boiler. Soil banked around the edges of the pan traps the steam. Pressure in the boiler is maintained at 100 pounds, 70 pounds of steam being the minimum for effective sterilization. Thirty minutes' steaming is sufficient for a given area, the pan being moved along to a fresh spot. The soil is so improved that less fertilizer is required to produce thrifty seedlings. The apparatus designed for tobacco beds, with slight modifications, can be applied in soil steaming in greenhouses, outside frames, and even in open fields. Plant diseases are thereby eliminated as well as weed growth stifled by killing the seeds of extraneous growth, and the way is thus laid open for a bumper crop in the absence of such competition.



Boiler and auxiliary apparatus for sterilizing tobacco seed beds, connected for practical performance

Platform corn harvester in operation. Two men with this machine drawn by one horse can cut and shock as much corn in one day as three men cutting by hand

When Oil Stops the Shifting Sands

BETWEEN Pendleton in Eastern Oregon and the mouth of the Columbia River the building and maintaining of the Columbia Highway has met aggravating conditions caused by the careless conduct of the wind that blows upstream almost constantly through the summer months. The high waters of the Columbia River in the spring carry down huge deposits of sand and silt. When the waters have gone down the sand remains, dries out and the wind carrying it away forms dunes similar to those found along the ocean beach or on the shores of Lake Michigan.

These constantly shifting sand dunes had to be tamed in some manner so after unsuccessful efforts to regulate things and to keep the dunes from encroaching upon the newly constructed stretches of highway it was decided to use oil. The oil was applied to the slopes as well as to the shifting sands as far as possible on either side of the road.

The equipment for oiling the sands consists of two supply tanks or drums and a tractor which draws the oiling rig and supplies steam to the compressor tanks carried on a trailer. The oil is heated by the steam and is forced through a hose with a nozzle made of a short piece of half-inch pipe. The oil is atomized by the steam and is sent in a fine spray for 100 feet or more. The distance the spray carries depends a great deal upon whether it is directed with or against prevailing winds. Where possible the spraying is carried on with the wind.

It is claimed by highway engineers in charge of this construction work that where sufficient oil is used this method is very effective and the cost will, no doubt, not be excessive.

The apparatus used in putting down the oil to make a road on sand

The Platform Corn Harvester

CORN is one of America's big crops, and its magnitude alone would suggest the difficulty of the task in harvesting the immense acreage. Moreover, corn-harvesting is limited to a few days if the feeding value of the fodder is to be completely realized. Speed is essential to cutting the corn for silage or fodder. Hence, the value of a platform harvester which can be purchased or made at home. The photograph herewith describes the two-row harvester. Two men with a platform harvester and one horse can cut and shock as much corn in a day as three men cutting by hand.

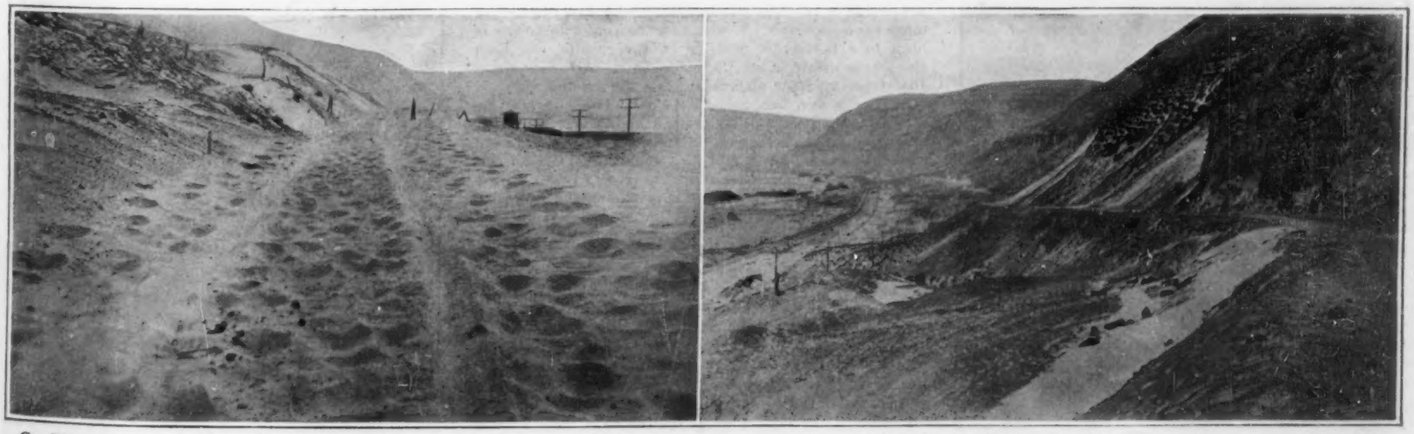
This machine is a sled platform or a platform mounted on small wheels, with knives attached for cutting the stalks. Home-made platform harvesters can either be mounted on sled runners or on wheels. The harvester is pulled by one horse and cuts two rows at a time. Two men ride on the platform to catch and support the stalks as they are knifed. When cutting corn for fodder, the horse is halted when the shock is reached, the operators carry the cut corn to the shock, return to the cutter, and proceed toward the next shock.

The original cost of a platform harvester ranges from $20 to $50, depending on the make-up of the machine. Devoid of many movable parts, the repair bills are almost negligible. Sharpening the knives usually represents the expense of upkeep. It is estimated that the machine can be operated at a cost of twenty-five cents an acre. Cutting corn with a corn binder is much more expensive, to take no account of the expensive investment of acquiring a cornbinder.

Non-Metallic Gear Material

UP to a few years ago practically all noiseless gears were made from rawhide or hard fiber. Both of these materials are unsuitable for timing gears, because they swell and distort when immersed in oil. Recently a number of non-metallic materials have been developed which have sufficiently high mechanical properties to permit of their use in toothed gearing and are non-sonorous and impervious to oil and alkalis. One of the latest of these materials contains two basic elements, a phenol-formaldehyde condensation product and a fabric.

The material is as strong as cast iron, is not affected by moisture or oil, is of a high dielectric strength and is inert, insoluble, and resistant to most acids.



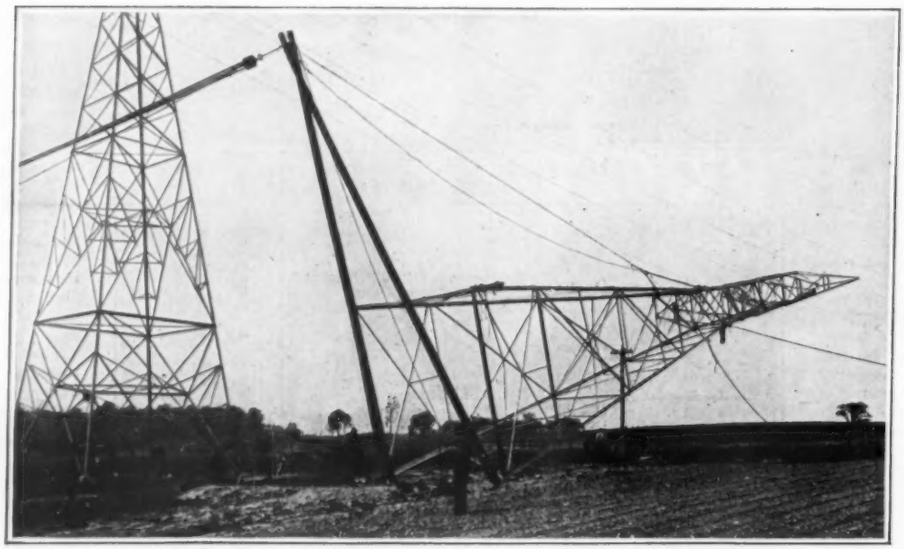
Condition of the Columbia River highway through the sand-dune district before (left) and after (right) the application of oil to the sand formation. The left-hand picture is actually of a finished and graded section of the highway, little as it appears so

Transporting Electric Current

Modern Transmission Lines and the Manner of Their Construction

By J. F. Springer

ONE of the great advantages of electricity as a source of power is the ease and certainty with which the power may be transmitted from point to point. This is one of the basic reasons for the gigantic developments of water-power sites in recent years. Such sites are often in locations far from any of the points where power is to be used. The nearest point of consumption may be 100, 200 or even more, miles away. The natural obstacles that intervene may be frequent and formidable. Where long distances are involved, the voltage is naturally set at an excessively high level; so that the problem of transmission becomes complicated with safety questions involving property and life. The total cross-section of conductor may be very considerable, because of the amount of current that is to be transmitted. This will be accentuated where some other metal than copper (as aluminum) is employed. In addition to the strictly engineering matters, the transmission engineer must consider cost. The entire development, including the transmission line, must make a reasonable profit. The reader may perhaps gather from the foregoing outline that the transmission problem may often become one of considerable difficulty.



Economy is the object of this surprising method of assembling the towers on the ground and tilting them up into the vertical position

In the older days, when the distances were short and the voltage low, the wooden pole was found sufficient. And today, where it is merely a question of supporting telegraph, telephone, electric light and trolley lines, the pole is in general use. It is usually of wood, but is sometimes of concrete or steel. But the steel tower is now rapidly coming into use, especially where heavy currents of high voltage are to be transmitted.

The wireless tower is a related affair. Its function is to support the aerial. While there are relatively few to erect, each unit may easily be a very considerable structure. In fact, the tallest steel towers erected in recent years are probably nearly all to be classed as wireless towers.

The wooden pole is in great use in connection with the transmission of electric current, especially where the weights to be carried are not excessive and where nearness to the ground of the conducting wires or cables is permissible. The erection of long, unwieldy and heavy poles is no trifling problem, especially if it be required that the expense per pole be kept at a low level. One method makes use of a derrick mounted on four wheels. If the poles are to be alongside a railway or trolley track, the movable derrick may have a track car for its supporting element. Mr. W. A. Ladue, a superintendent of a New Jersey public service company, built some years ago a special derrick wagon, which is able to erect poles at points 10 feet from the wagon. The derrick mast is supported at a point between the ends by an axle and a universal joint. It is temporarily guyed back by ropes attached to a ring at the top and to convenient points of attachment near by. The use of this apparatus may be taken as fairly representative of up-to-date practice with poles.

The wooden pole is, however, becoming obsolete where heavy power currents have to be transmitted considerable distances. To get the wires up to new levels and to carry heavier weights are requirements that have been met by the use of steel structures. Sometimes the towers are very considerable affairs, so that their actual erection at an economical expenditure requires careful attention. An analogous structure is the tower for a modern wind-mill. These are erected in more than one way. Sometimes the complete tower is built in a horizontal position on the ground, and then the whole affair is set up on its base. At other times the structure rises piecemeal from the ground up.

If the tower has quite a narrow base, it may be classed as a pole and be erected similarly. Likewise, the structure to be set up on end may be two adjacent uprights of a tower and the connecting framework. This may be set up after the manner of a tower with a narrow base. The procedure may pursue the following lines. The *gin pole* is relied on as the erecting appliance. In the present case, this may consist of a long and fairly heavy pole pierced transversely at intervals. A pair of wheels as an axle may be used to help in the transportation of the pole and in the earlier part of the operation of upending it. The axle may be passed through one of the perforations in the pole, the selection being made according to the conditions at the moment. A couple of ropes are secured to the smaller end of the gin pole. At the bigger end a triangular frame is secured to the pole in such way as to be in the same plane with the axle. The base of this triangle may be nothing more than a strip of wood so arranged at the end of the gin pole as to be perpendicularly bisected by it. The sides of the triangle may extend from the ends of this base to points on opposite sides of the pole. The result of this arrangement is to provide the gin pole with a broad base. When this base is put into contact with the ground—as by lifting the opposite end of the gin pole—and held against slipping, by stakes or otherwise, the gin pole may be made to rotate upward, on its triangular base as a hinge, by pulling on the ropes. This pulling may be done by hoisting engines or by man power. After the pole has been pulled up somewhat, its smaller end may be secured to a suitable point on the framework of the narrow tower. The foot of the tower is prevented from slipping by wooden stakes driven into the ground or by some equivalent means. If now the ropes to the gin pole be pulled on again, the pole and the tower may both be rotated, as hinges, until the tower has come to the vertical. Some reader may wonder why the gin pole is used at all and why the tower is not erected at once, just as the gin pole is erected, by pulling on the ropes attached to it. In answer to these questions, one may say that it is desirable to have a considerable angle, in a vertical plane, between the tower or pole and the rope attached. By first tilting the pole a sufficient angle is made possible for the moderate weight of the pole alone. Later, when a rope is arranged to connect gin pole and tower, there will be a considerable angle between this rope and the length of the tower.

It is quite customary to assemble and bolt or rivet together the complete tower in a horizontal position. The advantage of doing all of this work close to the ground must be well nigh obvious. However, it increases the difficulty of erection. Nevertheless, this method is probably more prevalent in the United States than the alternative of piecemeal erection in absolutely

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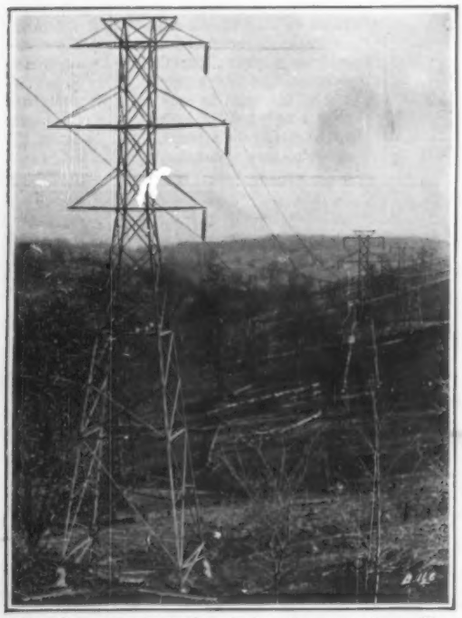
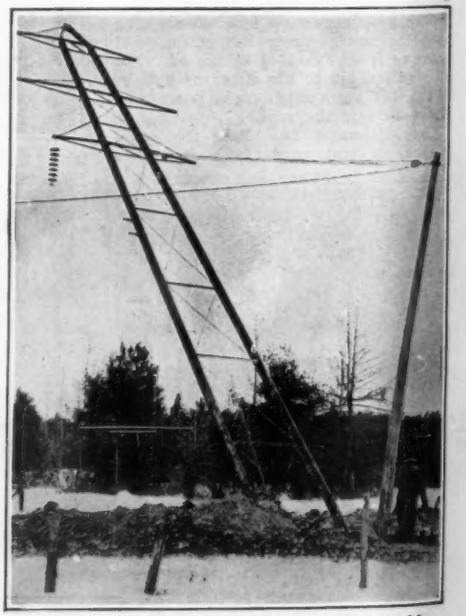


Another representative design for a modern all-steel tower



Erecting a flexible A-frame carrier for a double-circuit 66,000-volt line

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

The Value of Clean Windows

IT is all well and good to preach the gospel of the clean and airy window, but generally this practice is considered to be in the interests of some manufacturers of special windows or window cleaning compounds. So it is refreshing to have the same point of view brought out by an absolutely disinterested party—disinterested from the commercial standpoint, but very much interested in the health of the workers.

Writing in a recent issue of *The Times Trade Supplement* of London, an English doctor has some interesting things to say about sunlight and fresh air. The dirty window, states this authority, is a kind of screen between health and those who seek it. Like the coal smoke, it impoverishes the sunlight. Unlike coal smoke, it can be removed at a relatively small expenditure of trouble. Sunlight exercises a profound effect in killing the germs of disease. More important than this is its effect on the human being at work. This effect is becoming better understood as time goes on. Recently, Dr. Leonard, the well-known English authority, wrote:

"The citizen, by his indoor life and by the smoke and dust of cities, is withdrawn not only from the influence of sunlight, the radiant energy of which has undoubtedly a most potent influence on the cutaneous (skin) nerves and feelings determined by these, and probably a no less important influence on the blood and other tissues exposed to its action."

The dirty window, of course, shuts out what little of the sunlight this individual might obtain. As Dr. Hill points out, the winter life of a city dweller is a poor substitute at best for "a man's life." He spends his day within doors except for a brief walk to work or the train. The quickening effects of the sunlight are denied him even when the sunlight is available, for the dingy office or shop is provided against the penetration of that healing warmth.

This is all loss, continues our English authority. Men so weakened by their surroundings cannot and do not remain in good spirits. They become pale and irritable. They work badly and they develop distempers of the mind. Like sickly plants, they become the easy prey of disease. Their output is below that of which they are capable.

The lesson to be derived from the foregoing is that it is the part of good business administration to provide ample window space in the shop, office or factory building in the first place, and to keep such windows or any other windows clean at all times. Tests made on employees working behind dirty windows and the same employees working behind clean windows generally reveal a 5 to 15 per cent increase in efficiency. There is no question about the importance of ample light, particularly sunlight where possible, in the workaday world.

Organization Motion Pictures

IT is a well-known fact that motion pictures are being used for advertising purposes, some of the advertising films actually being shown in the smaller picture theaters, along with the usual productions. But the possibilities of employing motion picture films for organization work in the large and small plants alike have not as yet come to be appreciated by the business world in general.

There is no better way of telling a story or explaining certain machinery or work than by motion picture. It speaks the only universal language extant, to begin with; and whether the plant has Poles, Hungarians, Russians, West Indians and other miscellaneous races, or just plain Americans, the motion picture can be understood by all. Then the motion picture has an excellent technique when it comes to explaining an idea. It enables the various steps in the explanation to be taken up one by one, with close-ups and animated cartoons and even animated models to emphasize points. In fact, one motion picture film can be viewed by thousands of workers as often as may be necessary, as compared with the usual lecture method. Again, the motion picture commands undivided interest. If 5000 men are viewing a motion picture presentation it is a pretty safe guess that not more than a handful are not concentrating their attention on the screen. In that respect no bulletin, poster, individual letter or talk can compare with the motion picture, which positively leaves a permanent impression.

Organization films are intended to bring out certain ideas that will make for better work and better working conditions in any organization. For instance, some companies have had films made to show the various activities of the company, in order to instill a better understanding of the organization, its ideals and achievements, and also in order that the individual worker might have some idea as to where he or she fits into the general scheme of things. Films have been made showing the right and the wrong way of doing a given task. What better argument could be found than to show a worker a motion picture film which depicts the wrong way of turning out his work, along with the value of the merchandise which such labor has produced, and then to show the correct way along with the increased value of merchandise thus produced. The fact can be brought out that the more the worker produces, the more his earnings.

Fortunately, there are numerous firms specializing in non-theatrical work today. The cost of making special films is not prohibitive, particularly in view of the service which such films give. Non-theatrical projectors are now available in a wide variety of designs, for the projection of the standard sized celluloid film or the so-called Safety Standard film which is made of acetate of cellulose and is therefore slow burning, being approved for use anywhere and by anyone without special fireproof booth or license.

The Diesel Engine Ashore

THE mention of Diesel engines generally calls to mind a ship installation or even a submarine riding on the surface of the waves. Yet as a matter of fact it appears that the Diesel engine is making good progress ashore, and is to be found in many large plants. Thus one of the recent installations of the Diesel engine comprises four engines, each a 2000-horsepower, four-cylinder, two-cycle unit, built for the Phelps-Dodge Corporation, one of the largest mining companies in the world. These four Diesel engines are the largest of their type ever constructed for stationary use in this country, and in horsepower per cylinder they are said to exceed any Diesel engine ever built in the United States. Two of these engines are going to old Mexico and two to Arizona. They will be direct-connected to 1350-kilowatt alternating current generators to supply electric power for copper mines. Some conception of the enormous size of these units may be gained from the following facts: The height from engine room floor to top of engine is 23 feet; the total length, including generator, is 51¾ feet; the width, 19¼ feet, and the net weight, 650,000 pounds.

The Diesel type of oil engine is being rapidly adopted for municipal and general power plant use and especially for driving auxiliaries because it produces power at a lower cost than any other type of engine. Since the type we are referring to is of the two-cylinder design, it requires less floor space than those of the four-cylinder design, and having less weight, it reduces installation cost and fixed charges. It will operate successfully on a large variety of low grade fuel oils, the special atomizing nozzle taking care of oils from 28 to 12 deg. Baumé.

Another typical Diesel engine installation is a 1250-horsepower unit direct-connected to a two-stage compressor, which is installed in the power plant of the Detroit Copper Company at Morenci, Arizona. The compressor has a capacity of 6400 cubic feet when running at a maximum speed of 180 r.p.m. The output of the compressor is varied by changing the speed of the Diesel engine. This is accomplished automatically by an air governor which varies the speed of the engine between 90 and 180 r.p.m. to meet the demand for air.

Diesel engines are made for either constant or variable speed operation. Such machines as compressors, blowing engines, pumps, ice machines and so on are commonly driven by the variable speed type, while many notable installations of the constant speed type have been made in electric light and power plants, flour mills, textile works, ship yards, cement plants and mines.

Putting Waste Vapor to Work

THE manner in which the capacity of a heating plant for a paper mill was increased by the proper utilization of waste vapor, is described by W. H. Howell, Jr., in a paper read before the Technical Association of the Pulp and Paper Industry. This novel scheme is quite typical of what is being done in many progressive plants with a view to reducing their overhead as far as possible during these days of slack trade.

As Mr. Howell stated, the usual practice has been to heat fresh air from outdoors by carrying it over steam coils, blowing it into the room and taking out the moisture from the driers, either by having openings in the roof or with exhaust fans. This system has been quite highly developed and gives satisfaction provided it is properly installed.

At the mill referred to, this old system was in use, but as the production was increased about 100 per cent it was found to be inadequate. It was then arranged to ventilate the machine room with two fans. One exhaust fan is used for pulling moist air out of the machine hood to the economizer and a supply fan distributes the warm air to various points in the room. The hot outgoing air and the fresh cold air crisscross each other in the economizer without actual contact except through corrugated plates. The object of the corrugated plates is to enable the closest possible contact for transmission of heat from hot moist air to the cold fresh air, at the same time separating the moist air from the dry air. Both fans are belt-connected to a single 20-horsepower constant-speed electric motor.

In average winter weather (34° Fahr.) the economizer is able to raise the outdoor air to 107° Fahr. for distribution in the machine room in quantity sufficient for all ventilating purposes and without the use of any steam whatsoever. This result is accomplished solely by utilizing the waste vapor going out of the machine hood and still leaving a large quantity of vapor available for other heating purposes.

It was found that 107° was too warm for the comfort of the operators, and a certain amount of moist air was consequently allowed to escape into the atmosphere without passing through the economizer, so as to bring the air temperature supplied to the room down to 98° or 100°.

Mr. Howell stated that, so far as he knows, this is the first practical use of the idea on a large scale for heating and ventilating a machine room without the use of steam from the boiler plant. By its means first-class ventilation conditions are assured in a place that formerly presented a very difficult and expensive operating condition. Of course the intention is also to use such waste heat in some cases to assist drying operations in summer.

Wheel or "Snow-Burned" Rails

THERE is a prolific source of injury to rails which has attracted little attention considering its general prevalence; that is, wheel-burnt rails, so-called, says a report of the Committee on Safety of Railroad Operation to the National Association of Railway and Utilities Commissioners. The slipping of wheels causes abrasion of the metal at the running surface of the rail head, attended commonly with the generation of intense heat by the frictional resistance involved. The term "snow-burnt" is employed in some localities, having the same meaning as wheel-burnt, due to the fact that slipping of the wheels occurs during attacks on snow-drifts.

The heat generated on these occasions exerts a pronounced effect on the metal along the top of the rail. A thin layer of metal raised to a scintillating temperature, rapidly cooled by conductivity, renders the steel excessively hard. Less rapid cooling anneals the steel. Deep abrasion of the surface affords opportunity for the inception of a line of rupture. The large number of wheel-burnt rails and the small number of accidents which result from them indicate that ordinary injuries are not serious, but none can be regarded with indifference. This branch of the rail question is far more complicated than is realized.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Sectional view of brick wall in which a special plug has been inserted to take a wood screw

Screw Holes for Screwless Places

A NEW device which permits an ordinary screw or wire nail to be fastened permanently in tile, brick, metal, concrete, marble, slate, glass, plaster, or any other substance, has been perfected and is being used. Builders, plumbers, electricians, and other tradesmen as well as engineers and laymen will appreciate the advantages of such a practical and useful article, which can be quickly and easily installed for the hundreds of uses to which it is suited.

The new device consists of a hollow tube of longitudinal strands of jute fiber cemented in such a manner that when in position it is unaffected by moisture or temperature changes. It is applied by drilling a hole of the proper size in the material to receive the plug with a sliding fit. The plug is then inserted, and as the screw or nail enters the plug, the fiber strands expand, filling the pores and becoming an integral part of the substance in which it is inserted.

Tests made under actual working conditions have shown that this device withstands a direct pull of 100 pounds in plaster, 600 pounds in iron, and 1250 pounds in common brick, when a No. 14, 2-inch screw was used. A greater resistance was shown when an indirect pull was used.

Providing the Rake With a Cutter

FINDING it impossible by hand labor to keep Bermuda grass out of the two-acre lawn of the palatial home where he was employed as head-gardener, Albert Conrad of Pasadena, Cal., decided to do some experimenting. He fastened a long, sharp, broken knife-blade across a common wire rake, and hacked the running grasses and weeds with this. It encouraged his idea, and he set to work to chisel by hand out of cold steel what has come to be known as a cutter-bar rake. Each tooth, knife-like and pointed and set at a peculiar angle, is detachable so that it may be ground anew when dulled; and these teeth fastened against a sharpened bar, make an effective weapon with which to fight the wild grasses. A lawn is cut and combed by it, the fine grass passing through between the square-set teeth, while the runners and coarse roots are separated and drawn out by the quick jerk upon the handle.

For eighteen months this gardener used his new implement. Finding that a few helpers could do the work formerly done by fourteen; and seeing the rejuvenation of the old lawns, made new

Rake fitted with cutter bar to facilitate the work of gardening

by the combing and re-seeding that was now an easy matter, he finally secured patent rights and put the handy, sorely-needed tool upon the market. Thirty-six hundred are now in use in southern California. Park commissioners are finding them of special value in caring for large lawn-areas.

Mr. Conrad has also attached a little hoe to one end of a light-weight rake, (at right of photograph), which gives a worker a double implement. This lighter rake is used upon lawns in good condition, while heavier ones are necessary where old grounds are to be made new.

Taking the "Kick" Out of the Shotgun

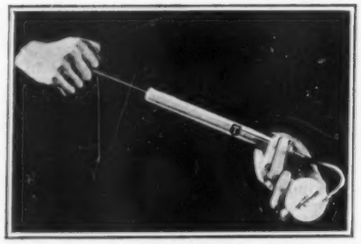
THE "kick"-less shotgun is a frequent object of ingenious inventors. While the recoil or "kick" of many different kinds of guns has been put to work by making it eject the spent cartridge shell and reload the gun, thus resulting in an automatic gun, for the most part such efforts have taken the form of ingenious though simple shock-absorbing stocks. One of the latest of such devices is shown in the accompanying illustration. The stock of this shotgun, it will be noted upon careful study, is divided into three parts, between which are placed suitable compressible springs. The springs can be adjusted for any desired degree of resistance or shock-absorbing qualities by the knurled wheels. It is claimed that this form of stock absorbs 70 per cent of the force of recoil.

Hot Water for the Country Home

THE problem of hot water in the country home is always a serious one. Of late years there have been several ingenious hot-water systems introduced, among them the automatic gas water-heater which automatically heats the water when a faucet is turned on in any part of the house. Where gas is not available, however, it would seem that some ingenious inventor could develop an oil water-heater that would also be automatic.

A Tennis Ball That Can Be Pumped Up

A NEW tennis ball manufactured by a New York concern may be pumped up like an automobile tire when it feels rather flat after a strenuous game. The inner ball of this tennis ball has a small knot of soft rubber attached to it and through this knot of rubber the ball is



Pumping up a soft tennis ball of new design, to make it like new

inflated before the outside felt cover is adjusted. When it is necessary to reinflate the ball the needle of the inflating device is pressed through an indelible

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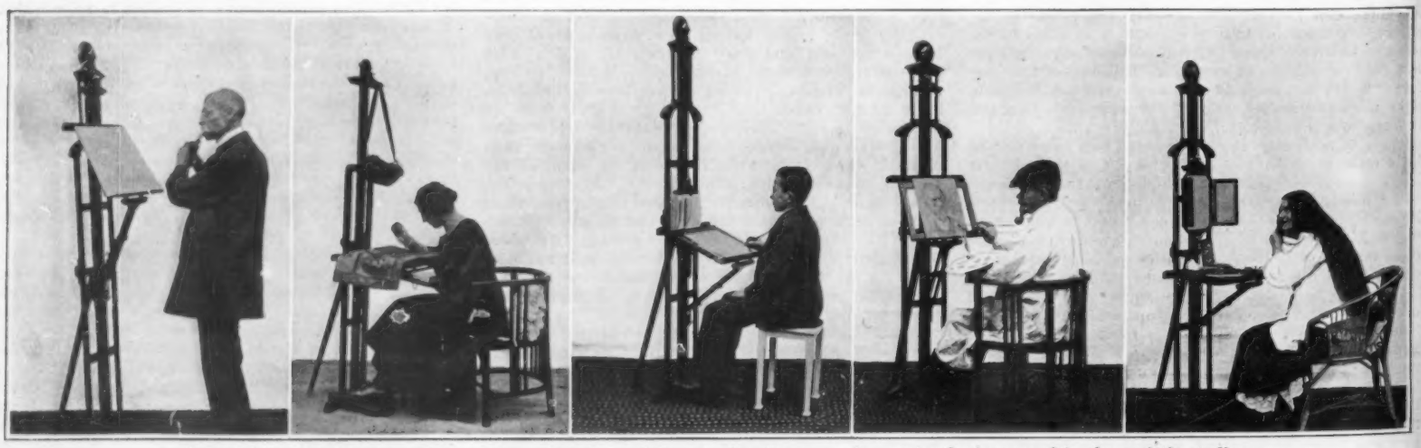
Stock of a shot-gun, provided with adjustable springs to take up the recoil or "kick"

cross marked on the cover. By pumping, the air is forced into the ball till it feels sufficiently hard for use. By pinching the ball with a pair of small pliers at the place the puncture is made; the sealing is made doubly safe as the knot of soft rubber closes up after the needle point has been removed.

An All-Round Piece of Furniture

FROM Germany comes the all-round piece of furniture shown in the collection of photographs at the bottom of this page. This piece of furniture is a highly ingenious combination of easel and table, and may be used for a variety of uses. First of all, it may be used as a music stand, as shown in our first illustration. The housewife may find it handy as a rest for her needlework, while the student may use it as a book rest and writing desk. The artist could hardly find a better easel than this simple piece of furniture. The fair sex, by means of a large mirror and the table attachment, can convert the same piece of furniture into a dressing table.



Some of the many uses to which an ingenious piece of German furniture may be put in the home and in the artist's studio

What Are Vitamines?

(*Continued from page 76*)

Recently the discovery has been made that the food richest in vitamines is yeast, of the sort we have always thought useful chiefly for making bread and beer. As early as 1852 an English physician named Moss reported the successful use of yeast as a medicine, but nothing came of it. There appeared no good reason why a man should take yeast, for instance, when affected with stomach trouble.

But in 1917 Dr. Philip B. Hawk, of Jefferson Medical College, published the results of an intensive research which he had conducted with yeast, and gave new impetus to the interest of the medical profession. Since then a number of eminent physicians have collaborated in this work and at least two of the largest hospitals have loaned their facilities to the investigators.

It now appears that there was a very good reason for the English doctor's "foolish" notion, although he himself did not suspect it. Yeast contains in highly concentrated form the Vitamine B, and is particularly useful as a general conditioner. Says Dr. Hawk in one report:

"In many of the cases which came under our observation, the yeast treatment caused an improvement in the general physical condition of the patient quite unassociated with improvement of the symptoms of the particular disease in question."

Diseases which appear to improve from the yeast treatment include stomach troubles of all kinds, constipation, rundown and nervous conditions, loss of weight and appetite, boils, blackheads, and others. The improvement appears to come from the stimulative effect of the vitamines on the glands, especially those of the digestive system, combined possibly with some other unexplained properties of yeast.

Another significant conclusion was drawn from the feeding of yeast to rats:

"A scrawny lethargic animal, rather dwindling in size, with unsleek coat and evident malnutrition, will completely change its appearance and responses in a few days at most on a diet unchanged except for a tiny bit of yeast."

Undoubtedly many persons are suffering from a lack of sufficient vitamines. We use only the starchy part of our wheat, polish our rice, peel our vegetables and fruits and thus remove from our diet most of the vitamines. General health could without doubt be improved by replacing these lost elements. In this connection an eminent physician recently suggested that we eat at least a quarter of the skin of each orange because it is rich in vitamines.

Dr. R. Adams Datcher of the Division of Agricultural Biochemistry of the Minnesota Agricultural Experiment Station has experimented in the feeding of vitamines to farm animals.

"From the standpoint of the stock feeder as well as from the sociological standpoint," he says, "this work suggests two important things which merit emphasis: first, the question of diet in relation to sexual vitality, sterility, etc., and secondly, the importance of fresh green foods for all growing animals, especially poultry. We have cured limberneck in fowls by administering a vitamine extract prepared from wheat germ.

"It is very possible that the laxative action of many fruits, whole grains and bran is due in a measure to increased gland secretion brought about by the vitamine stimulation. As a result of our observations we wish to state tentatively that the actions of the organs of internal secretion are dependent upon the stimulating action of the vitamines. Whether this is in the nature of a nerve stimulant, nuclear nutrient, or chemical nucleus of a hormone is of course a matter of speculation."

But we are interested here, not so much in the improvement of the general health during normal lifetime as in whether this line of experimentation offers any hope that human life can be extended beyond the one-hundred-year mark which, so far, has been nearly always the absolute limit of life. Will it not be possible when the vitamines themselves, their effect on the glands, and the effect of the glands on the body are better known, to live for two hundred or five hundred years?

We may reasonably conclude from the scientific evidence already at hand that such a thing is plausible, at least. There seems to be no doubt that the potential immortality of the cells which compose the body has been established. There is a growing volume of evidence, perhaps not conclusive, but making the probability very great, that old age is induced principally by the failure of certain glands which exert a mysterious but a very real influence upon all of the bodily tissues. Finally, the life and vigor of these glands seems dependent upon the mysterious food element, vitamines.

It is too soon to draw positive conclusions, but certainly the path to a vast new field of research is now cleared away which field may hold tremendous results for the human race.

Home Building Simplified

(*Continued from page 79*)

to their six- and eight-room dwellings when economic conditions are again settled? I do not think so. I know of one case in the middle-west where a new apartment house has been built beside an old-style one. The new apartments have three rooms, as against six in the older one. The quality of the buildings is about the same, but the three-room apartments rent for more than the neighboring six-rooms. I know personally that every one of the small but entirely modern and convenient apartments is rented all the time and that ever since they were built the owner of the six-room suites has had trouble in keeping tenants."

Aside from influencing the development of space-saving devices, which are revolutionizing interior arrangements, the housing shortage has also had the effect of stimulating invention in new types of building materials and in the perfection of others.

In the SCIENTIFIC AMERICAN of May 28th last there was described in detail the plan of Mr. Simon Lake for building small monolithic hollow-wall concrete units in centralized factories, the complete unit to be delivered on a special truck to the lot, ready for occupancy. The construction apparently overcomes previous objections to concrete homes in that it is damp-proofed, permits of an infinite variety of designs, and does not require the erection and tearing down of costly forms at the building site.

In this connection another small housing unit which has recently made its appearance is of interest. In this case sheet iron is used in the construction which has many novel features. The chief feature of the house is that no nail or hole pierces the galvanized metal, so there are no points at which rust can attack the metal. The outer walls are made of No. 20 gage sheet steel, galvanized and painted, and formed into sections 24 inches wide, with a rigid pressed steel stud in the center of each section. These sections interlock with each other and the edges are held in place and reinforced by iron rods, which run through the sections lengthways, holding the roof and eaves securely in place, and being bolted at the bottom to angle-iron sills. The roof also is of galvanized sheet steel and together with the outer walls forms a rigid water-tight all-steel structure. Inside this shell the finishing is done with ordinary woodwork. Walls and partitions are made of half-inch asbestos wallboard nailed to wooden studding and rafters. As an added insulation against heat and sound all exterior walls are lined with

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felt. Under the present selling plan the complete house, 20 by 36 feet, containing four rooms and bath, is sold and erected complete with plumbing and lighting fixtures for a little less than $2000. The house may be extended lengthwise as desired in two-foot units, but cannot be made more than one story in height.

For the man who wishes to build a distinctive home from his own plans, there is interest in new building materials and in the improvements in old ones, notably in stucco construction.

One of the latest materials is a development of the asphalt shingle. In this case the asphalt base is made much heavier than usual and a coating of ground slate pressed on the surface. It is used in large standardized slabs as siding.

The latest development in stucco work is the recommendation from the Bureau of Standards, which is being generally accepted by builders, that when metal lath is used the customary wood "sheeting" be dispensed with and instead one coating of cement be stuccoed on the inside of the wall. This completely imbeds the metal lath in the cement, protecting it from corrosion; makes the wall more fire-proof; and gives other desirable qualities. Insulating paper is nailed on the inside studding and over this are placed the furring strips, to which is nailed the expanded metal lath for the inside plaster finish. This method differs radically from standard practise and the requirements of many city building codes, which call for a solid board sheeting under the outside stucco; but it is backed by scientific investigation.

A Newark, N. J., inventor has placed on the market a new stucco base which holds the promise of remarkable results. It is in the form of slabs of inch-thick porous concrete, nearly as light and as strong as wood, which are nailed directly to the studding of the house. Only two coats of stucco are then required to finish the wall. The inside is plastered as usual.

The porosity of the concrete is secured in a most ingenious fashion. Small pellets of parafin or some similar material are mixed with sand and portland cement and the mixture spread in slabs over wire mesh reinforcing and allowed to set for a day and a half. Then the slabs are placed in an oven and subjected to a high degree of heat. The parafin is melted and driven off through the pores of the concrete, the fumes caught and condensed by distillation and used again in the form of pellets, and strange as it may seem, this heating does not affect the structure of the concrete but merely interrupts the setting process until the slab again cools off. The product is surprisingly light and strong. It is believed that the only similar product now on the market is a light concrete manufactured by a Belgian firm, in which sawdust is an ingredient.

While it may appear that this method would make the slabs prohibitive in cost, the maker claims the finished building, because the labor item is lower, costs about the same as by any other method of stucco working. It is claimed that the insulating qualities of the porous wall are very marked.

A number of patented stucco mixtures have also made their appearance on the market, and qualities are claimed for each. Such mixtures are said to be superior to ordinary cement stucco and the material is entirely damp-proof, more elastic, desirably colored, and so on.

Since houses are at a premium more attention is being paid to making them fireproof. A scheme has been devised by a number of manufacturers of metal lath, for rendering an ordinary frame building so nearly fireproof that it would be hard to burn it down. This is done by the erection of firestops at all vulnerable points, as under all bearing partitions and stud exterior walls, ceilings over heating plants and coal bins, at chimney breasts, around flues, back of kitchen ranges, around stair walls and under stairs. The plan adds about $200 to the cost of a $5000 house.

All in all, the man who has waited to build his home until conditions are more settled can profit by some very remarkable housing developments for his waiting.

Tomorrow's Airships

(Continued from page 80)

In this case the figures are based on an airship of 3½ million cubic feet, which can be constructed in England without difficulty by a slight extension of the existing sheds. This ship is calculated to have a gross lift of 105 tons and a disposable lift of 68 tons. The estimated speed at full power is 75 m.p.h. and the endurance, carrying 15 tons of passengers and freight, 80 hours or 1800 miles.

The proposed route to New York from London is via Portugal and the Azores, to take advantage of the better weather conditions, the distance being 3600 miles and the time taken 60 hours. The return journey would be made by a direct crossing of some 3000 miles and time taken would be 50 hours.

With four airships working it is anticipated from an examination of weather records that crossings would be practicable on 300 days in the year, and that 200 crossings could be maintained. Fifteen tons would admit of 140 passengers and their luggage to be carried, or 50 passengers and 10 tons of mails.

Synthetic Agriculture

(Continued from page 81)

What used to be called theory has proved to be of the utmost practical importance, so among the practices derived from this knowledge is the inoculation of newly reclaimed land, not with pure cultures, but with soil from a nearby field which had borne a leguminous crop the previous year. These bacteria spreading slowly through the soil should be harrowed in, and in no case left exposed to the burning sun. This insures a good first leguminous crop where otherwise failures had often to be recorded.

The climate has not been studied enough up till now in connection with crop production. It plays an important part, in so far as it allows the obtaining of higher crops, when full advantage is taken of its action.

Machinery and implements are chosen on the principle that only one type is best suited to the work it has to perform. Deep working of the soil is one of the great assets of synthetic agriculture. Sometimes it is necessary to proceed gradually but the final results are: better aeration; humus, bacteria and feeding elements for crops brought deeper; improved water supply, deep rooting encouraged, crops suffer less from heat, and closer cropping can be indulged in.

Subsoiling has a marked effect on most of the crops; harrowing and especially sowing are more often done too shallow than too deep and the most favorable depth is seldom attained.

Rolling and hoeing have most remarkable effects; they are not used to the full extent justified by their usefulness. For instance, in summer a crop is brought up rapidly by rolling, but once the tap root down, the surface must be broken to check evaporation. The effect of hoeing has been translated by several people into something tangible like: once hoeing equals a shower, but twice equals a dressing; but still the dressing value is often left aside.

Transporting Electric Current

(Continued from page 84)

final position. The gin pole is usable where the weights do not become considerable. With heavier structures, a pair of shear legs may be substituted for the ordinary gin pole. These are two long poles so set as to lean toward each other, thus forming the sides of a tall and narrow isosceles triangle. The feet of these side poles may be secured to a horizontal member at its ends. This complete triangle may then be used much after the manner of the single gin pole.

It is highly important that all preparations be completed by the moment actual hoisting to position begins. It seems that accidents during the actual erection are not so infrequent. A tower may easily drop when erection has reached a point where the tower is at a 45 degree angle. If the tower slips at the location of the "hinge," any amount of trouble may ensue, not to say loss of life or limb. A good deal of attention has been given to the matter of this "hinge." One of the successful devices consists of a stout iron pipe which is employed as the axle of rotation. The tower will naturally have two legs on the ground. Over the feet are secured shoes made of angle bars. These shoes are so shaped as to fit well and permit of being bolted to the foot through the regular rivet holes. Each shoe is provided with a steel loop so fixed as to project beneath the sole. The hole in these loops is, say, five inches in diameter. When the shoes have been bolted in place, the bottom legs of the tower will have two loops, one to each leg, forming, as it were, prolongations of the legs. A 4-inch iron pipe is passed through the two loops. This pipe is of a length to permit, say, 1 foot to project beyond each loop and to form the "hinge" on which the tower is to turn during the erection operation. In order to prevent the pipe itself from slipping sideways on the ground, a loop at the end of a steel cable is passed over each projecting end, and the cable itself is secured at a convenient point on the side from which slippage, if it occurs, is to be expected. Pins driven into the ground serve to provide the proper points of anchorage.

When a tower is being erected by the shear-leg method, it is important that the erecting operation be not permitted to proceed too far. It is said that many towers have dropped because of having been pulled too far over. To guard against this, wire rope is attached to the head of the tower and carried back on the side from which movement is to take place. Naturally, this line, which is to be used substantially as a guy rope, must yield to allow erection to go on. But it must be carefully controlled, and there must be sufficient resistance to prevent the erecting pull from going too far. Fortunately, the maximum resistance does not have to be exerted the instant the tower axis becomes vertical. There will be no substantial danger of falling over, in the erecting direction, until the center of gravity reaches the vertical plane through the "hinge." This means that the maximum length of the back guy rope does not have to be fixed beforehand with great exactness. The rope should be long enough, but not too long; and there is a considerable margin permissible. Consequently, it is proper to secure the ground end of the rope to a suitable anchorage.

A single team is able, under ordinary conditions, to erect a 5,000-pound tower, with a pair of shear legs used in the manner described. If the tower is of double this weight, three teams may be required. Naturally, one may use a tractor instead of teams of horses or mules.

The length of spans between towers has been the subject of a good deal of study. Experience with very short and very long spans has led to the conclusion that, when everything has been taken into consideration, long intervals between towers is the preferable practice. First cost will sometimes be greater, because of the height and weight of the fewer towers; but the maintenance of lines with long spans is decidedly less. And this is an item that must be considered. Not only is maintenance less, but troubles from interruptions of service are reduced.

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